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1950

GUATEMALAN IVORY-BILLED WOODPECKER

PHLOEOCEASTES GUATEMALENSIS

One-half natural size

Painting by Andrew Jackson Grayson

THE CONDOR

VOLUME 52 JANUARY-FEBRUARY, 1950 NUMBER 1

THE DIVING AND FEEDING ACTIVITY OF THE WESTERN GREBE ON THE BREEDING GROUNDS

By GEORGE E. LAWRENCE

These observations on the subsurface feeding habits of the Western Grebe (*Aechmophorus occidentalis*) were made to determine how this species is able to compete successfully in the underwater community as a predator. The methods of food capture, the time of day of greatest activity, and the specific food sources, were general objectives of the study. Field work was conducted in the breeding area at Clear Lake, Lake County, California, from April through September, 1947.

Clear Lake is an irregularly shaped volcanic lake over seventeen miles long and six and one-half miles wide; it is constricted at the middle to a passage less than one mile in width and fifty-six feet deep. Mountains of the Coast Range surround it on all sides, and the surface is 1325 feet above sea level. The lake is ideal as a breeding grounds for grebes because of the extensive stands of common tule (*Scirpus acutus*), which border much of the lake. These tule belts are several hundred feet in width in some marginal areas, the individual stems standing six to nine feet high. Presence of submerged sand bars is often revealed by dense growths of tules which form islands of swaying stems and floating plant material. The water temperature readings taken three feet beneath the surface showed a range of summer temperatures from 52°F. to 81°F. The air temperature readings in the same period were 42°F. minimum and 95°F. maximum.

DIVING BEHAVIOR

In watching the diving behavior of the Western Grebe, it became apparent that the pattern of movement was not always the same. Dependent upon the stimulus which caused the diving reaction, there appeared to be five or more distinct patterns. The most common type of dive is what will be referred to as the "feeding dive." This basic pattern occurs only when the surface of the water is smooth and unbroken by large waves. It involves a deliberate, forward and downward thrust of the head and a vigorous stroke of the feet, which propels the grebe beneath the surface in an effortless appearing dive. This type of dive is evident throughout the diurnal feeding period. It causes a minimum of splashing and allows the grebe to approach the underwater prey with little surface disturbance.

The second type, the "springing dive," is employed most widely under conditions of strong wind and rough water. All dives by the grebes observed in the San Francisco Bay area and on the ocean off Tomales Point, Marin County, in February, March and April of 1947, were of this springing type. On the breeding grounds at Clear Lake this type of dive would often be evident in the late afternoon when the water surface was ruffled by moderate winds. The movement consists of a vigorous leap forward and downward into the water. The head is arched upward slightly, then forward and downward, accompanied by a strong thrust of the hind limbs, causing the forepart of the body to spring entirely clear of the surface and reenter the water more than twelve inches for-

ward of the original position. The considerable surface disturbance and splashing which is involved in this springing dive is nullified by the already disturbed water surface and whitecaps. An additional feature of the springing dive is the orientation into the wind; all the dives are made directly into the waves. This orientation does not influence the direction of underwater exploration, however, as the diving of a grebe at 4:45 p.m., on July 16 at Clear Lake illustrated. This large adult consistently dived toward the westerly afternoon wind, but would reappear at the surface at right angles or occasionally behind the point of entry.

The third type, or "alarm dive," was observed only rarely. It represents a part of an elaborate pattern of escape movement from a vulnerable, exposed, surface position. An observation at 10:50 a.m., on May 21, 1947, demonstrated this alarm diving pattern. The observer was sitting on an exposed rock at the lake margin watching a pair of grebes, when a particularly long, 61-second dive carried the nearest grebe within 20 feet of the observer's position. Shortly after surfacing, a movement alarmed the grebe, causing the frightened bird to thrust its wings outward and virtually push the body beneath the surface. Thus with considerable splashing the grebe disappeared almost instantaneously. As the alarmed grebe dived, it was possible to see several wing beats of the partly folded wings. The murky water of Clear Lake obscured vision more than thirty inches beneath the surface.

The fourth pattern of diving was observed on June 16, 1947, in a narrow backwater at the northern end of Clear Lake. A single grebe was diving at the inner reaches of the narrow channel when it became aware of the approach of the observer in a canoe at the mouth of the backwater. The grebe suddenly appeared near the canoe. It then dived in an effort to reach the open lake with a minimum of exposure of its body on the surface. This "surface dive" was a porpoise-like action. The grebe was able to continue its escape, not exposing the hind part of the body at any time but simply breaking the surface of the water with the head and neck, which allowed rapid inhalation for the continued rapid swimming.

The last pattern of diving behavior is linked with the final phase of the courtship behavior for which this species is widely noted. Following the shrill *kreeeee kreeeee* notes of the mating grebes, and the second phase of ballet nodding movements, the two grebes rise upward on the water, with necks outstretched. They rush across the surface erect with rapidly beating feet and wings, then disappear beneath the surface at the end of the 150-foot rushing action. The final movement in this elaborate and impressive nuptual behavior pattern is the "courtship dive" which terminates the surface rushing action. Folding the wings simultaneously, the grebes disappear into the water, the head being the last part of the body to sink from view.

On May 29, 1947, in the tule-bordered northern Clear Lake area, a single pair was observed to complete this courtship pattern seven times within the hour from 9:40 to 10:40 a.m. Through the months of July and August when the birds were nesting, this courtship pattern was continually observed but with less frequency. The final record of this behavior occurred on September 2, 1947, when a pair of grebes displayed the same spectacular behavior of the mating period.

DAILY ACTIVITY CYCLE

The position of the Western Grebe in the aquatic community is restricted by specific physical factors within the diurnal period of activity. The time-community relationships of this species have been studied intensively to find out the periods in which the grebes are most active and what environmental factors determine the increased or decreased activity.

After measuring the length of time spent in each dive and the time of each resting period, it became convenient to express these periods in a ratio, which will be termed the dive-pause ratio. The dive-pause ratio for any particular period, therefore, will be the ratio of the time spent beneath the water, to the time pausing on the surface of the water in any series of dives. This diving activity was recorded over a seven-month period. Over 1700 dives were noted, representing different times of day, different individuals, and activity in varying depths of water (table 1).

Table 1

Compiled Data of Diving Activity of the Western Grebe

Inclusive dates	Number of individuals observed	Total minutes of readings	Number of dives recorded
April 1-30	12	231	114
May 1-31	19	547	284
June 1-30	31	973	473
July 1-31	26	696	345
August 1-31	23	589	322
September 1-30	14	422	209
Totals	125	3,548	1,747

The arithmetical average for all dives recorded reveals an underwater time of 30.4 seconds while the average of all pause periods shows 21.3 seconds. The average dive-pause ratio for all periods is 1.41.

Figure 1 illustrates the dive-pause activity of individual grebes feeding at different periods of the day. The bar graph is designed to indicate by dark areas above the divid-

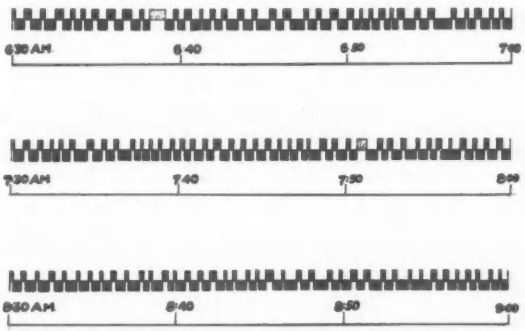

Fig. 1. Dive-pause activity of three adult grebes feeding at the same location on May 15, 1947. Blocks above median line indicate pause periods, blocks below line dive periods; dotted areas indicate rest periods.

ing line the time spent resting or pausing; the time spent diving beneath the surface is shown below the line. The long pauses or resting pauses or resting periods are included in the graph and influence the dive-pause ratio correspondingly. The first series from 6:30 a.m. to 7:00 a.m. recorded on May 15, 1947, give an average dive-pause ratio of 1.97. The readings from 7:30 a.m. to 8:00 a.m. show a 2.13 ratio and the period from 8:30 a.m. to 9:00 a.m. reveals the highest recorded ratio, 2.73. This comparison of

samples points to a peak of feeding activity between 8:30 a.m. and 9:00 a.m., when the time submerged is almost three times the pause time on the surface.

The dive-pause ratio may be used as the index of activity of any period during the activity cycle of the species, and it becomes useful to determine this figure for each hour of the day. The earliest morning activity recorded was on June 20, 1947, when a pair of adults was observed paddling slowly about near the tules at 4:22 a.m. No diving activity was observed until nearly 5:00 a.m. when the dives were spaced between long pauses. This feeding activity before sunrise was exploratory, as no instances of successful food capture were observed.

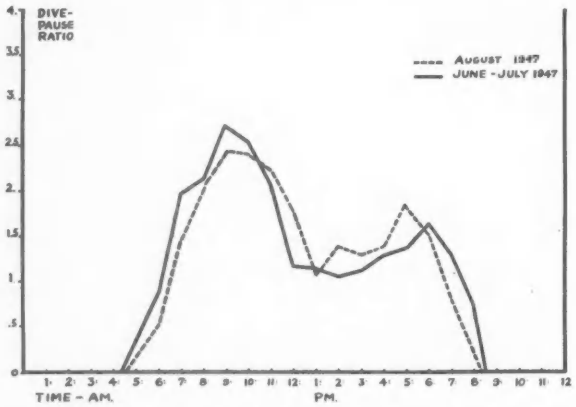

Fig. 2. Average dive-pause ratios for June, July and August, 1947.

This morning feeding activity did not reach a peak until three and one-half hours later when the sun was well up over the water of the lake. Figure 2 illustrates the average hourly variation in the daily activity cycle of the Western Grebe. The rapid increase in activity is evident before 9:00 a.m., after which time there is a gradual decrease in feeding and diving until 2:00 p.m. This decrease is then replaced by another late afternoon peak at 6:00 p.m. when the ratio reaches 1.61. This ratio indicates only that the period spent below the surface was one and one-half times longer than that spent above. After 6:00 p.m. in midsummer, the ratio decreases very rapidly as the light fades and the latest observed diving grebe was seen at 8:33 p.m., on June 22, 1947.

The method used in compiling the graph of this activity cycle was to time the individual dives and pauses of many different birds over the entire seven-month period from March to September. These figures were grouped by the hour and hourly ratios determined by dividing the total time below water by the total time above water.

Dewar (The Bird as a Diver, 1924) has presented a principle called the time-depth rule. He studied some 6000 dives of many species and concluded that the length of the dive was directly correlated with the depth of the water; dives of one fathom or less require twenty seconds. For each additional fathom in depth an additional ten seconds are added. The rule would be interpreted, then, to mean that all dives of twenty seconds would occur in water of six feet or less in depth, while in water of two fathoms depth thirty-second dives would be used, and in three fathoms of water forty seconds would be required.

The data on the Western Grebe do not confirm the rule. First, the grebes did not dive invariably to the bottom in search of food, although small white pebbles which served as the evidence for bottom feeding were present in the stomachs, as reported also by Dewar. An instance which reveals the depth to which the grebes often dive follows: On May 27, 1947, observations were being made from a bridge over the northern tip of Clear Lake when a feeding grebe dived near the bridge and swam for a distance of thirty feet while less than three feet submerged. The total depth of water was six to seven feet at this point, and the grebe appeared to be exploring the mid-depths. The method of swimming was by regular strokes of the hind limbs; the leg movements were at a rate of fourteen strokes every ten seconds. The neck was not fully extended and the wings were folded at the sides, as they were not employed in this unhurried progression.

The second line of evidence which does not corroborate the time-depth rule is related to the fact that the average depth of water near the tules where the greatest amount of feeding is accomplished, is six feet, varying from four and one-half feet to nine feet. Most of the dives recorded were in water of these depths, and there appeared to be no correlation between length of dive and water depth. The longest dive recorded was 63 seconds and soundings revealed the water to be only five and one-half feet deep. In a shallow lagoon extending north of Clear Lake, on June 12, 1947, 10:20 a.m., a series of thirty dives was recorded in water only four feet deep. The time spent beneath the surface did not vary from that of dives in water eight or nine feet in depth. These dives in the shallow water averaged thirty-one seconds and ranged from twenty-two seconds to forty-six seconds. The Dewar time-depth rule would indicate dives of less than twenty seconds in this water only two-thirds of a fathom deep.

Such a physical factor of the environment as the afternoon wind, which ruffles the surface of the water, tends to cause a general movement of the diving birds several hundred yards out into the lake, where preening and resting replace feeding activity. During this period of the daily cycle a tendency to form loose aggregations is evident, and as many as ten or twelve individuals may be observed far out on the lake within a radius of 80 feet. In such a group there are always two or three grebes which are alert to the approach of disturbances; the other individuals may be preening, resting, or sleeping with the head tucked back under one wing. This sleeping position makes the individual especially vulnerable because the grebe appears to float very high in the water and the amount of white along the flanks is conspicuous. The loose flocking behavior of the early afternoon periods therefore appears to serve a protective function.

During other periods of the day territoriality is operative. This spacing serves to hold to a minimum the disturbance of underwater prey by the surface activity of grebes. At least two hundred feet of open water normally separates feeding individuals.

An additional physical factor influencing the grebe in its daily cycle is light intensity. The relatively late peak of activity at 8:30 a.m. is two hours retarded in comparison to other non-diving birds. The factor here is lack of underwater visibility. Although the grebes venture forth from the tules as early as 4:22 a.m., there is only intermittent diving until the angle of the light which strikes the water is high enough to allow penetration and permit the grebes to pursue underwater organisms. An observation which tends to confirm this conclusion is that of a grebe which was seen to dive continually close to the tules at 7:15 a.m., on June 23, 1947, but dived only on the west side of the lagoon in the direct rays of the morning sun. Other birds feeding toward the center of the lagoon did not approach the opposite east bank where the tules cast a shadow well out into the lake. This habit of avoiding shaded water during feeding periods has been noted on many occasions.

The abrupt cessation of diving in the evening suggests reduced underwater visibility.

After about 7:30 p.m. during June, July, and August, grebes may be seen swimming about slowly in the fading light but the actual feeding and diving stops when the light is insufficient to see the underwater prey.

In order to determine the exact minimal light intensity which permits activity, a standard light sensitive photo cell, Number 917A, was used with current supplied by a large dry battery and readings were made directly on a microvoltmeter. The extreme sensitivity of the equipment limited the measurement of morning readings to levels of two feet and three feet beneath the surface. It was determined that the murkiness of the water, owing to silt and algal content, caused the readings to be decreased by an exponential factor of one-seventh less for each foot in depth below the two- and three-foot levels. These microvoltmeter readings were converted into a standard General Electric light meter scale of foot-candles light intensity. The intensity readings at 8:30 a.m. on August 16, 1947, during a maximum activity period of the grebes show the following values at two to eight feet below the surface.

Table 2
Light Intensity Beneath Surface

Time of readings	Depth of water	Light intensity in foot-candles
8:30 a.m.	2	0.61
8:30 a.m.	3	0.087
8:30 a.m.	4	0.0138
8:30 a.m.	5	0.0021
8:30 a.m.	6	0.00032
8:30 a.m.	7	0.000043
8:30 a.m.	8	0.0000058

As indicated by the table, the adult grebes capture aquatic organisms in light intensity readings ranging from 0.61 foot-candles to 0.00032 foot-candles at six feet beneath the surface, the usual maximum feeding depth in upper Clear Lake. These figures apply to the optimum active feeding period of the daily cycle. During the relatively inactive period at 2:00 p.m., the light intensity reaches its maximum of 3.00 foot-candles at two feet depth (figure 3).

On June 20, 1947, at 7:18 p.m., a bird dived slowly in open water some 28 minutes after the sun had left the sky. This individual was active in minimal light intensities of 0.023 foot-candles at two feet beneath the surface and 0.0000014 foot-candles at six feet deep, the maximum depth at this point. This diving activity does not represent normal feeding behavior, and no instances of successful food capture were observed in such adverse lighting conditions.

The occurrence of the morning peak of activity appears directly correlated with the period at which the sun's rays strike the water at a high angle. This condition permits effective underwater visibility at the six- to nine-foot levels. The adjustment of the iris in the eye of the grebe must be rapid to permit clear vision when ascending from the darkened deep water to the glaring brightness of the surface, involving a range of light intensities from 0.0000058 to a maximum of 158 foot-candles in direct sunlight.

In analyzing a further physical factor, that of temperature, as it affects the activity cycle of this species, it becomes apparent that weather bureau readings of air temperatures are not usable, as they are not recorded at the levels of grebe activity. Readings were taken, therefore, at the subsurface level of two feet during August, 1947, at Clear Lake, and air temperatures were taken from Fish and Game Commission readings at five feet above the surface. The more significant water temperature readings during

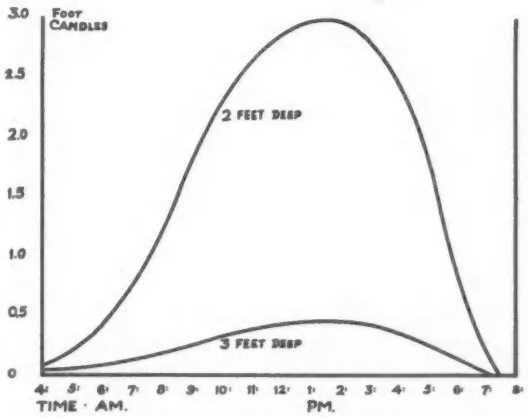

Fig. 3. Light intensity readings measured at 2 and 3 feet beneath surface of Clear Lake on August 16, 1947.

August, 1947, are given in figure 4; the hourly averages range from 20°C. or 68°F., to 27.7°C. or 82°F. These temperatures are unusually high for such a large body of water, but as the floor of the lake slopes very gradually toward the center, the margins may be no more than eight feet in depth for several hundred yards from shore. The lake is not drained or fed by running streams during most of the year; thus the water stands quite motionless, and little mixing occurs between the cool, deeper levels and the surface water which is warmed by the sun's radiation.

Figure 4 also illustrates the range of the more variable air temperatures from the minimum average hourly readings of 12.8°C. or 55°F. to 33.8°C. or 93°F. maximum.

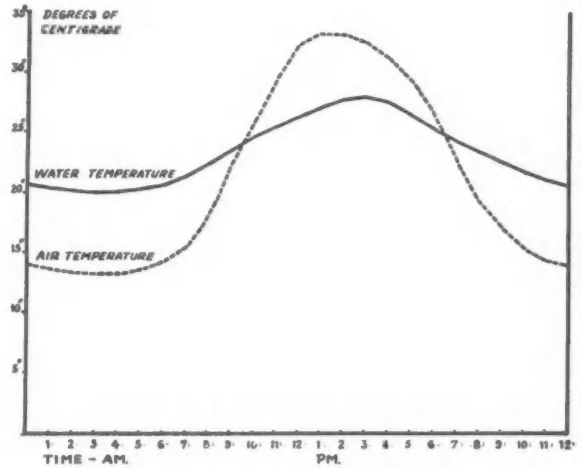

Fig. 4. Temperature averages for August, 1947, at Clear Lake.

The peak of air temperature precedes the peak of water temperature readings by more than one hour and the late afternoon decline in air temperature is much more rapid than that of the water. The influence of temperature on the daily activity cycle of the Western Grebe apparently is indirect. The rise in water temperature causes a corresponding decrease in the oxygen-holding capacity of the water. As the amount of available oxygen in solution decreases during the warm mid-day period, there is a decrease in activity of the fish and insect life. The decreased movement of the food source organisms apparently determines in part at least the decline in grebe activity during the warm part of the day from 10:30 a.m. to 4:30 p.m.

The necessity for a proper balance of these two physical factors, light intensity and underwater temperature, is apparent. During the hours of dawn and twilight, oxygen content of the water is high because the water is cool and the food organism activity is therefore great. This time of day does not permit optimum feeding activity, however, because the light intensity is very low, limiting underwater vision. The mid-day period illustrates the reverse situation with the light factor at a high level but the underwater temperature excessive for the best feeding conditions. The two peaks of daily activity cycle therefore indicate the periods when these two factors of light and temperature are in proper balance, thus allowing underwater feeding of maximum effectiveness.

FOOD HABITS

In order to determine the foods used by the Western Grebe on the breeding grounds, contents of stomachs from collected specimens were analyzed. This technique made possible an examination of the relatively insoluble materials consumed during the previous feeding period. The time of collection was normally late afternoon, but in some instances was after the activity peak of the morning. Thus, the maximum opportunity for the stomach contents to represent the result of a normal feeding period was obtained.

Six adult individuals were examined each month during the four-month period from June through September. The results of all collections are tabulated in table 3. At this season, the birds were present in large numbers in the Clear Lake area. Collections in May included only three.

In analyzing the contents of the stomach, all material from the esophageal tract was forced into the stomach, the stomach removed, and the contents washed to extract silt and mud. The remaining mass, including feathers and traces of food materials, was then separated under 24× magnification, so that all insect exoskeletal parts, fish scales and vertebrae could be recovered for identification. The mass of stomach contents varied from 60 to 88 millimeters in diameter, depending on the overall size of the grebe.

An earlier study by Wetmore (U. S. Dept. Agr. Bull. No. 1196, 1924) reported the Western Grebe to be entirely piscivorous. The individuals then analyzed, however, were taken from widely distributed points along the Pacific coast, a majority of them from salt-water habitats.

The present study, on the fresh-water breeding grounds, indicates that the diet of the Western Grebe is not wholly fish. During the entire period under study, there were more findings of insects than fish, numerically. The occurrences of insects totaled 146, while those of fish totaled only 91 individuals. These numerical data obscure the true picture of actual bulk of the two food types. Insects constituted an estimated 17 per cent of the total food volume, whereas the smaller number of fish fragments contributed 81 per cent. Two grebes showed no trace of fish vertebrae or scales in the stomach contents, while considerable insect material was present. The mandibles and head parts of 29 predacious diving beetles of the family Dytiscidae were found in the stomach of an individual taken in June, insect material constituting the entire diet of this grebe.

Further evidence of deviation from an entirely piscivorous diet is the occurrence of the uneroded shells of two small limpets, resembling immature *Acmaea mitra*. These gastropods were found in a grebe taken on June 16, 1947; the shells may have been exposed to the digestive juices of the bird for two weeks and possibly longer. The salt water distribution of limpets indicates that these shells were carried in the grebe's stomach from the Pacific Ocean in the inland migration of April or May.

Table 3

Analysis of Stomach Contents of Twenty-seven Western Grebes

Classification of material	Number of occurrences	Per cent of occurrences	Per cent of total volume
Nematoda			
Ascaradina			
Ascaris sp. (alimentary parasites)	122	61	3
Mollusca			
Gastropoda			
Acmaea sp. (small limpets)	2	3	1
Arthropoda			
Orthoptera (mouth parts only)	9	4	2
Ephemerida (May fly larvae)	4	3	Trace
Hemiptera			
Corixidae			
Sigara sp. (water boatmen)	41	54	2
Diptera			
Chironomidae (larval forms)	5	11	1
Coleoptera			
Carabidae			
Bembidion sp. (ground beetles)	4	3	Trace
Dytiscidae (predacious diving beetles)	32	11	2
Hydrophyllidae (water scavengers)	1	2	Trace
Dryopidae (aquatic beetles)	7	11	Trace
Unidentified Coleoptera	43	34	2
Pisces (Chordata)			
Siluridae			
Ictalurus catus (common catfish)	3	11	4
Centrarchidae			
Archoplites interruptus (perch)	5	19	6
Lepomis macrochirus (bluegill)	67	92	71
Unidentified fish fragments	13	31	Trace
Plant material unidentified	28	27	4
Small white stones (1-5 mm. diameter)	99	37	6
Feathers occurred in all stomachs			

A large number of nematode parasites of the genus *Ascaris* were recovered from the feather masses of the grebe stomachs. These roundworms were all free in the alimentary tract; none appeared attached to the walls of the stomach. An individual grebe taken in June, 1947, was found to contain 34 nematode worms in the feather mass of the stomach. Current studies being conducted by the California Fish and Game Commission indicate that this same parasite occurs in the alimentary tract of the common catfish, *Ictalurus catus*, but an analysis of the host-parasite relationship remains to be made.

The insect material found in the stomach contents presents the problem of distin-

guishing between those insects which were captured directly by the grebe and those fragments which were contained in the stomachs of captured fish. The arbitrary means of distinction was on the basis of size of the insect involved. Certain very small tenebrionids, nocturnal beetles of only four to six millimeters in length, were excluded from the report of insect findings because of their minute size. The traces of grasshopper mouth parts represent insects nearly as large as many of the smaller fishes taken by the grebes and therefore presumably were captured directly by the avian predator. At no time in the period of observation were feeding grebes observed to take insects from the surface of the water. Capture of floating insects may have been accomplished by an underwater approach as the grebe comes to the surface. Rarely was the insect material sufficiently intact to permit more than family identification due to the grinding action of the walls of the bird's stomach and the erosion by digestive juices.

Three species of fish were identified in the stomach contents, the common catfish, the Sacramento River perch, and the bluegill perch. Of these three, the bluegill constituted 71 per cent of all the food materials ingested, on the basis of volume. The fish taken by the grebe vary in size from 27 millimeters to 88 millimeters in length, all in the second year of growth. This species, the bluegill perch, is a wide-ranging shoreline fish, found in water from 3 to 19 feet in depth. The factors which contribute to make the bluegill perch the primary food source of the grebe are the abundance of this fish in the grebe breeding areas, its light color, its great dorsoventral depth and its wide distribution in all parts of the lake. The largest object taken by the grebes was a bluegill 88 millimeters in length and 34 millimeters in depth. This is remarkable in view of the narrow buccal orifice of the grebe.

The other species of fish, the Sacramento River perch and the common catfish, were found uncommonly in the stomach analyses. The catfish is ecologically significant, however, as an indicator of bottom feeding by the grebes. The difficulty of capturing the catfish and the Sacramento perch is probably due to the very dark dorsal and lateral aspects of these two species.

The best structural features for identifying the fragmentary fish material were the midline lateral scales. Without these scales and without the body outline and pattern of fins, no identification beyond class was made.

In addition to the food materials specified, other materials of less certain function were revealed in the stomach analyses. Plant material appeared in 31 per cent of all stomachs examined, the plant tissues resembling aquatic roots or underwater stems. This plant material was found in small quantities throughout each monthly collection period.

Non-digestible materials in the nature of small stones were found in 37 per cent of the grebes. These pebbles may serve as grinding elements, aiding in the food breakdown process. A large number of flattened egg cases, 2 to 3 millimeters in diameter, were present in more than half of the stomachs. These remain unidentified. They were either pure white or light brown. A knotted piece of strong braided twine, 122 millimeters in length and resembling a piece of fishing cord, was found in one stomach.

The feather mat which occurs in the stomach of the Western Grebe was found in all analyses. A generally accepted view is that its function is to protect the stomach walls from being punctured by sharp bones during the grinding action of the walls. In addition the feathers prevent undigested sharp bones from passing on into the lower alimentary tract before they have been softened by digestive action (see Wetmore, *op. cit.*). Undigested fish usually are situated on the periphery of the feather mat. In this position the feather mass serves to keep the recently taken materials close to the secretory surfaces of the stomach walls, thus speeding up digestion. The sharp bones and

hard undigestible materials were regularly found to be within the center of the stomach mass. This central position protects the stomach walls and facilitates the straining function. The undigested bones move to the protected center of the stomach by the gradual encumbrance of the exposed bones with feathers as the digestion of the soft parts progresses. When the lateral or dorsal spines of the vertebral column become exposed by this erosion, feathers may be observed tangled about the projecting bones, and when the musculature is entirely digested, the skeletal structures are obscured by the entwined protective feathers. The regular churning action of the stomach walls moves this solid mass of tangled feathers and bones to the inner part of the feather mass and new undigested material takes the peripheral position in the stomach.

Fig. 5. Bluegill perch from stomach of an adult male Western Grebe, taken at 5:50 p.m., 6 miles northeast of Lakeport, California.

The Western Grebe does not regurgitate undigested bones, scales and chitinous parts. These sharp objects have been found in many states of erosion by digestive action. Vertebral segments often were found discolored and spineless in the very center of the feather mass. The presence of the limpet shells and small stones also indicates that material not readily digested remains in the grebe stomach until it is softened or eroded.

The actual food-capturing mechanism of this predator is indicated by indirect evidence only. The observation of May 27, 1947, demonstrated how the grebe dives and progresses underwater. On this occasion the observer was able to follow the movements of the grebe as it moved a distance of thirty feet. The grebe swam only three feet beneath the surface, with its head drawn back slightly, wings held at the sides, and the legs stroking together. This was an exploratory dive, however, as are over 96 per cent of all dives. The evidence shown in figure 5 provides further information as to how grebes capture prey. The fish in the stomach of this male bird were recently taken and all clearly showed a small hole passing completely through the fish. The consistent appearance of this aperture, its location near the center of the body of the fish, and the similarity between the size of these openings and the diameter of the bill of the grebe, suggest that the sharp bill of the bird may serve as a rapier in piercing the fish.

An observation of June 28, 1947, shows that the fish may be moved into the mouth before surfacing. On this date a single isolated bird was under observation for a con-

tinuous period from 6:40 a.m. to 11:50 a.m. Early in the morning, at 8:05 a.m., the grebe emerged from a dive holding its head at an abnormally high angle. Gradually, after some effort, the head assumed its normal position horizontal to the water, and a swelling appeared high in the neck, causing an unnatural curvature in the neck. This swelling slowly moved downward in the esophagus until the neck again appeared natural in size and curvature, at which time the grebe dived. During this morning observation this swallowing behavior was seen only two times, being repeated again at 10:16 a.m. when another object large enough to be observed through 8× glasses was passed down the esophagus.

These field data also give evidence of the number of fish captured during a normal morning feeding period. The grebe just described would apparently take only four fish during the daily feeding cycle if the observed rate of food capture represents the normal situation. The fish shown in figure 5 are all eroded only slightly and evidently were taken the same day. The stomach contents of the grebe described above as catching two fish during the entire morning feeding period, revealed fragments of five fish present; three of the five were much eroded by digestive action and may not have been taken the same day.

Wetmore (*op. cit.*) reported as many as nine fingerling smelt present at one time in a Western Grebe stomach; these would compare closely in total volume with the maximum figure of seven of the broad-bodied perch of Clear Lake found in one grebe. Using the figure of 3.2 grams as the average weight of the perch taken, the maximum weight consumed in one day's feeding therefore would be 22.4 grams of fish. This small amount of food taken daily equals only 1.8 per cent of the body weight of the adult grebe. This is a low rate of food intake relative to the consumption rate of some other predators which may eat more than 50 per cent of their body weight daily.

Several of the species of fish in Clear Lake are important as game fishes. The large-mouthed black bass (*Micropterus salmoides*) is the most important of these species, although the perch and catfish are also taken as game fishes. Worthy of attention is the fact that no individuals of the black bass were recovered from the stomachs of the Western Grebes. This game fish occurs regularly in the same ecological area with the grebes, but the fact that it is not taken by the birds may be due to its slimmer body form and greater speed, as compared to the bluegill perch. The Western Grebe has been illegally killed by the sportsmen of the area on the claim that the birds were "eating all the young bass." The birds could more reasonably be accused of lessening the perch population of the lake, but the relatively few grebes consume only a small fraction of the young perch. They probably have no effect on the size of the adult population of this type of fish.

During the period of study from late April through September of 1947, the types of foods taken by the Western Grebe varied in proportion. Figure 6 illustrates the changes occurring in the per cent of total volume consumed during each month on the breeding grounds. The maximum insect consumption occurs in May, making up 32 per cent of the total diet during this month when the insect populations are at a peak. As the summer progresses the aquatic insect populations decrease so that toward the end of the breeding season the insect material contributes less than 8 per cent of the total volume. The fish taken make up the bulk of the diet throughout the entire period. In May, 64 per cent of the food volume is fish; this figure increases steadily through the season until in September, just before the fall migration to the marine habitat, 86 per cent of the entire diet is made up of fish. The plant material, which remains a fractional part of the diet throughout the period, may not represent a basic food source and occurs only as accidentally consumed material.

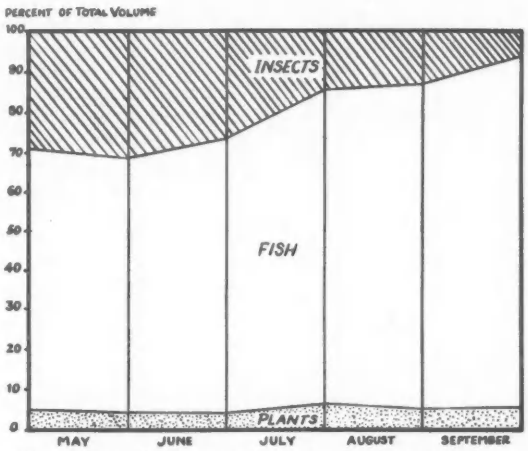

Fig. 6. Seasonal changes in food taken by Western Grebes at Clear Lake.

SUMMARY

The patterns of diving behavior of the Western Grebe (*Aechmophorus occidentalis*) are designated as the feeding dive, the springing dive, the alarm dive, the surface dive, and the courtship dive.

The courtship behavior was observed throughout the entire five-month period from May to September, 1947, at Clear Lake, California, continuing after the appearance of young.

The daily activity cycle was analyzed through hourly records of the dive-pause ratio. Activity reaches a peak between 8:30 a.m. and 9:00 a.m., at which time a maximal ratio of 2.73 occurs. The arithmetical averages for the 1700 dives of the Western Grebe recorded show 30.4 seconds beneath the surface (dive) and 21.3 seconds above the surface (pause).

The time-depth rule of Dewar is not corroborated by the diving behavior of this grebe. The longest of all subsurface dives recorded was one lasting 63 seconds. This individual was diving in water 5½ feet deep.

Flocking activity was observed only during the early afternoon hours. At that time, grebes were relatively inactive and gathered in groups of ten or twelve far out on the lake, where they preened and rested.

Of the physical factors influencing the activity cycle of this species, wind, light intensity, and water temperature were examined in some detail. Light intensity is critical in underwater predation, as grebes do not begin feeding in general until light values exceed 0.00032 foot-candles at 6-foot depths.

The water temperatures at Clear Lake reach 27.7°C. (82°F.) two feet beneath the surface during the middle of the day, especially between 1:00 and 3:30 p.m.; the amount of dissolved oxygen in this warm water is then decreased and activity of prey is retarded. Subsidence of hunting by grebes in mid-day may be correlated with reduced activity of prey animals.

The investigation of the food habits of this species revealed a diet consisting of fish (81 per cent), insects (17 per cent), and plant material (secondary traces). These find-

ings do not confirm the claim of earlier workers of an entirely piscivorous diet of the Western Grebe. Seasonal variation in food occurs, with insects ranging from 32 per cent of volume in May to 8 per cent in September. There is compensating variation in the per cent of fish.

The fish species constituting the majority of the grebe's diet was the bluegill perch, *Lepomis macrochirus,* which occurred in 71 per cent by volume.

The feather mass which completely fills the stomachs of all Western Grebes appears to function to protect the inner lining of the stomach from the sharp bones of fish; it also prevents undigested bones from passing into the lower alimentary tract.

The maximum weight of fish consumed in a single day is 22.4 grams, which represents only 1.8 per cent of the body weight of an adult grebe.

The influence of this avian predator on the game fish of Clear Lake is negligible because of the very small number of relatively unimportant game fishes consumed. The claim that this grebe is reducing the numbers of black bass (*Micropterus salmoides*) is entirely unfounded in view of the stomach analyses.

Acknowledgments.—Greatful acknowledgment is made for the aid given by Harry P. Chandler of the Fish and Game Commission in all insect identifications, to Garth Murphy for help in fish identification, to Dr. Ellsworth C. Dougherty for nematode identification and to Dr. Alden H. Miller for his generous guidance throughout the period of the study.

Museum of Vertebrate Zoology, Berkeley, California, and Bakersfield College, Bakersfield, California, April 29, 1949.

BIRD COMMUNITIES IN THE CONIFEROUS FOREST BIOME

By DANA PAUL SNYDER

The tendency of organisms to form more or less distinct biotic groupings has led to many attempts at classification of such units. The early classifications dealing with North America have been summarized by Merriam (1892), who in turn proposed the life-zone system based on the distribution of both plants and animals (1890). Daubenmire (1938) has summarized the important criticisms of the life-zone concept. Dice (1943) has recently developed the idea of the "biotic province" as an aid in the classification of ecological communities. Each province has a continuous geographic distribution and is regarded as an evolutionary unit. Since the concept has not yet been widely applied, it cannot be properly evaluated.

Perhaps the most useful classification of communities at the present time is that developed by Clements and Shelford (1939). In this system the largest natural unit, identified by the life form of the climax dominant vegetation, is called the biome. Important in this system is the recognition of developmental or seral communities as distinct from the climax community. Another emphasis of this system is upon the abundant or otherwise significant organisms rather than the uncommon species.

The biome concept is undergoing still further development. From a study of biome maps one is likely to infer that the communities within each biome are always more closely related to each other than to communities in other biomes. Such is not always true. For example, deciduous forest may occur as a developmental community within the coniferous forest biome. The plant and animal constituents of such a deciduous forest often have more in common with the deciduous forest biome than with the climax coniferous forest community. This situation was pointed out for birds by Pitelka (1941). Kendeigh (1948) has introduced a subdivision, the *biociation,* into the biome classification that takes care of these inter-biome relations. The biociation is an animal community of definite taxonomic composition occurring in vegetation of a uniform type of life-form. Such a community may be climax in one biome, but seral, a *biocies,* in another.

The present study was undertaken to investigate the organization of bird communities within the coniferous forest biome. Breeding bird populations were measured in three vegetation types of the coniferous forest during the summer of 1947, in the vicinity of Science Lodge, the biological station of the University of Colorado. This station is situated just east of the continental divide in Boulder County and is approximately 21 miles west of the city of Boulder, Colorado.

The writer wishes at this point to express his appreciation to Dr. S. C. Kendeigh of the University of Illinois under whose direction this work was carried out. His suggestions and corrections have been of great assistance in compiling data and completing the manuscript. The writer is indebted to Dr. Gordon Alexander of the University of Colorado for suggestions and supervision of the field study. Thanks are due the University of Colorado for the use of equipment. The aerial photographs are from the files of the Forest Service. The map is redrawn from the Forest Service map of Arapahoe National Forest, 1938.

BIRD POPULATIONS

Procedure.—Study plots for censusing breeding birds were set up in three forest communities, each community characterized by different plant dominants. The plots varied in size and shape as a result of difficulty in finding representative sites.

The climax montane forest in this region is dominated by ponderosa pine, *Pinus ponderosa,* and Douglas fir, *Pseudotsuga taxifolia.* There are two shrub layers, chiefly

Juniperus communis and *Arctostaphylos uva-ursi,* prostrate on the forest floor, and *Ribes, Jamesia, Ceanothus,* and other shrubs, growing erect. The montane forest is open, and therefore a number of grasses, sedges, and forbs are found. The community in this part of the Rocky Mountains extends from an elevation of about 5400 feet to approximately 8400 feet on north-facing slopes and 9500 feet on south-facing slopes. The two dominant species tend to separate into consociations at certain points, the pine inhabiting the drier situations and the Douglas fir the moister spots.

The climax subalpine forest is dominated by subalpine fir, *Abies lasiocarpa,* and Engelmann spruce, *Picea engelmanni.* In certain exposed rocky areas these dominants are replaced by limber pine, *Pinus flexilis.* The lower shrub stratum is composed chiefly of scattered stands of *Vaccinium.* This community extends from the upper border of the montane forest up to 10,500 feet in this part of Colorado.

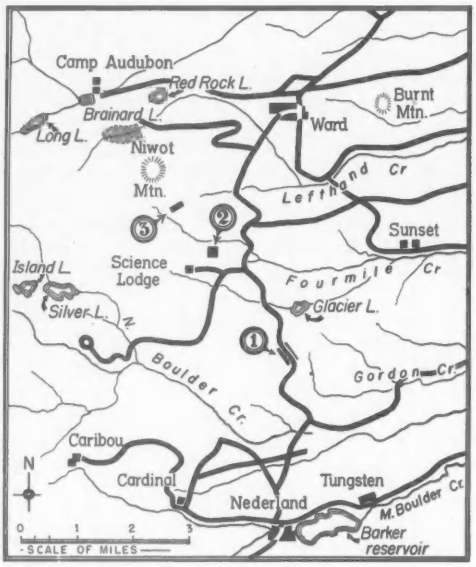

Fig. 7. Location of census plots in Boulder County, Colorado. 1, Douglas fir-ponderosa pine; 2, lodgepole pine; 3, Engelmann spruce-subalpine fir. Roads represented by heavy black lines.

Since Lodgepole pine, *Pinus contorta,* occurs in both the subalpine and the montane forests and since it frequently remains as a subclimax for a great length of time, it forms an important forest community. Therefore, an intermediate census area was selected in a nearly pure stand of this species for comparison with the other two communities which have two species as dominants.

Plot 1, in the montane forest, measured 200 by 450 meters which made an area of 9 hectares (22.2 acres). It was situated at an elevation of 8800 feet. A number of lodgepole pine trees and a few stands of aspen were scattered among the ponderosa pine and Douglas fir. A road ran through the long section of the plot which decreased the area

actually covered with forest. However, no correction was made in the size of the census area as many of the birds made use of the space. Plot 2, situated at an elevation of 9500 feet in the lodgepole pine forest, was 300 by 300 meters, making an area of 9 hectares (22.2 acres). Young trees predominated and formed very thick stands over parts of the area, although small openings occurred in a few places. Limber pines were present along the north edge of the area, and a very few were scattered throughout the plot. Plot 3, in the subalpine forest, was 150 by 400 meters or 6 hectares (14.8 acres) in area. The effective census area, however, was only 5¾ hectares (14.2 acres), since a meadow 50 by 50 meters occurred along one edge. The plot was located at an elevation of 10,200 feet. It contained a stand of limber pine in one corner which accounted for about 20 per cent of the canopy, the remainder being made up of the dominants of spruce and fir.

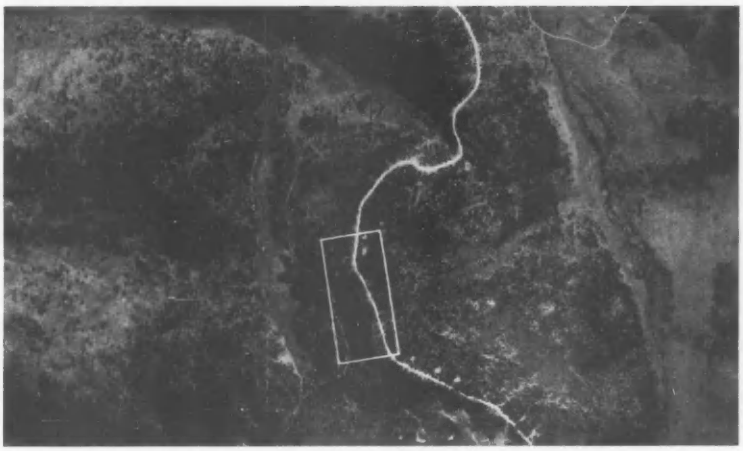

Fig. 8. Aerial view of plot 1, the Douglas fir-ponderosa pine forest. Top of photograph is north.

The plots were laid out in the form of grids by pacing with a compass. The intersections at 50 meter intervals were marked by blazing and assigned numbers. Thus, any point within the plot could be quickly located on a map of the area. The locations of the various areas are shown in figure 7. The location of each plot in relation to the surrounding topography is shown by aerial photographs, figures 8, 9, and 10. On each photograph the census plot is enclosed by white lines.

The bird census was taken by traversing back and forth over the entire plot, keeping between two adjacent blazed lines. When a bird was seen or heard, it was spotted on a map of the census plot. After each plot had been covered five times, individual maps were made for each species so that the approximate boundaries of the territories, and thus the number of breeding pairs, could be counted (Kendeigh, 1944). These figures were then converted into the number of pairs per 100 acres (40 hectares). Species with less than one-half of a territory were listed with a plus but not counted in the total number of pairs present. When a number of partial territories of a species extended into the plot, they were added together. The density of each species is given to the nearest whole number.

The last major snowfall of the season occurred on June 11 and 12. A small amount

of snow fell on June 22. Censusing was begun on June 23 and lasted until July 31. Censuses were usually taken from daybreak to 10 or 11 a.m. but a few were made later in the day. Nesting was well under way at the time censusing began. The Canada Jay, Steller Jay and Clark Nutcracker had apparently completed nesting activities, so

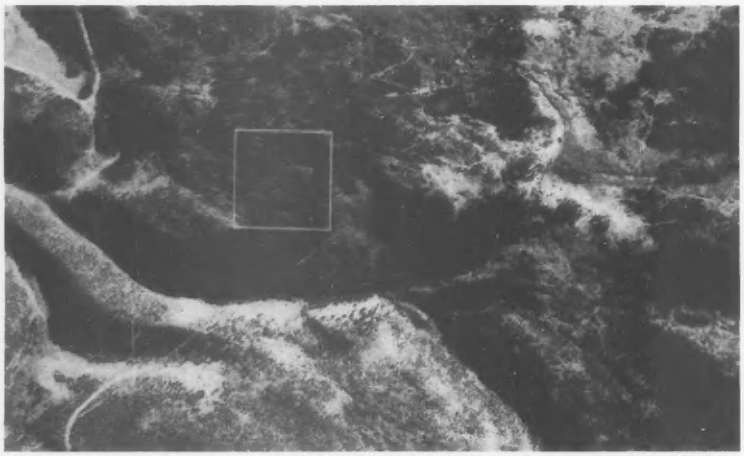

Fig. 9. Aerial view of plot 2, the lodgepole pine forest. Top of photograph is south.

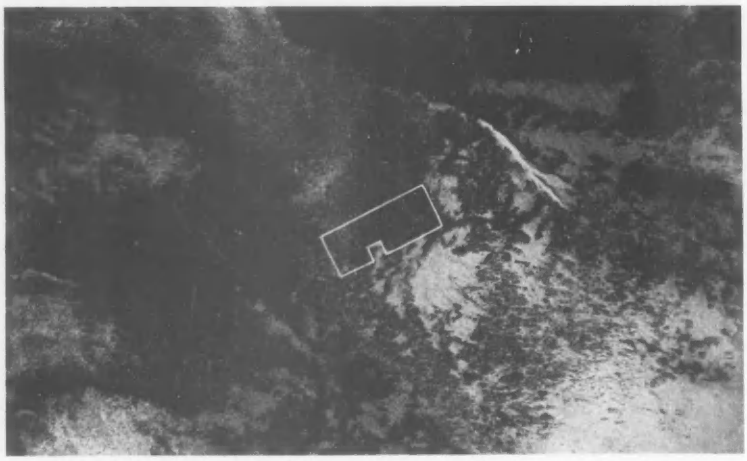

Fig. 10. Aerial view of plot 3, the Engelmann spruce-subalpine fir forest. Top of photograph is south.

that their abundance could not be ascertained. The population figures for the Pine Siskin are based on the frequent observation of single individuals often in flight. The density as given is apparently higher than normal for the species but is believed to indicate fairly closely the actual population in the summer of 1947.

Census results.—The breeding populations of the birds are summarized in table 1. The Goshawk, Red-tailed Hawk, Prairie Falcon, and Raven were seen in the region but not frequently enough to obtain an estimate of their populations. When the three forest communities are considered together, the best represented families in number of species are the Fringillidae, the Turdidae, and the Corvidae. However, on the basis of individuals, the families stand in the order: Fringillidae, Sylviidae, Turdidae, and Paridae. Other families are represented by much smaller numbers of individuals. When the number of individuals is considered for each plot separately, the order of abundance is similar, except for the entire absence of the Sylviidae in the lodgepole pine forest.

Table 1

Breeding Birds of the Coniferous Forest in Colorado

	Actual counts			Density per acres (40 hectares)		
	Plot 1 Douglas fir—ponderosa pine	Plot 2 Lodge-pole pine	Plot 3 Engelmann spruce—subalpine fir	Plot 1 Douglas fir—ponderosa pine	Plot 2 Lodge-pole pine	Plot 3 Engelmann spruce—subalpine fir
	9 ha.	9 ha.	5.75 ha.			
Sharp-shinned Hawk, *Accipiter striatus*	+	0	0	+	0	0
Dusky Grouse, *Dendragapus obscurus*	0	+	1—	0	+	4
Mourning Dove, *Zenaidura macroura*	+	0	0	+	0	0
Nighthawk, *Chordeiles minor*	0	1+	0	0	5	0
Broad-tailed Hummingbird, *Selasphorus platycercus*	1+	0	0	5	0	0
Red-shafted Flicker, *Colaptes cafer*	0	+	+	0	+	+
Hairy Woodpecker, *Dendrocopos villosus*	+	0	1	+	0	7
Canada Jay, *Perisoreus canadensis*	0	+	0	0	+	0
Steller Jay, *Cyanocitta stelleri*	0	+	0	0	+	0
Clark Nutcracker, *Nucifraga columbiana*	+	+	+	+	+	+
Mountain Chickadee, *Parus gambeli*	3—	2	2—	12	9	12
Red-breasted Nuthatch, *Sitta canadensis*	+	0	0	+	0	0
Brown Creeper, *Certhia familiaris*	+	0	0	+	0	0
Robin, *Turdus migratorius*	2—	+	0	8	+	0
Hermit Thrush, *Hylocichla guttata*	2	3	1+	9	13	8
Townsend Solitaire, *Myadestes townsendi*	0	+	+	0	+	+
Ruby-crowned Kinglet, *Regulus calendula*	4	0	4—	18	0	28
Audubon Warbler, *Dendroica auduboni*	1	+	1—	5	+	6
Pine Grosbeak, *Pinicola enucleator*	0	0	1—	0	0	4
Pine Siskin, *Spinus pinus*	2	5+	4—	9	23	25
Red Crossbill, *Loxia curvirostra*	+	1	+	+	4	+
Gray-headed Junco, *Junco caniceps*	8	1+	+	36	5	+
				102+	59+	94+

+ Indicates density below one-half pair.

The density of breeding pairs for the montane, the subalpine, and the lodgepole pine forests are 102+, 94+, and 59+, respectively. The density for the subalpine forest is low compared with similar forests in the east. Kendeigh (1947) found 319+ pairs per 100 acres near Black Sturgeon Lake in Ontario, Cadbury and Cruickshank (1947) listed 273 pairs per 100 acres on Hog Island off the coast of Maine, and DeGarmo (1948) gives 313+ pairs per 100 acres (two year average) for young spruce in West Virginia. The Ontario census was carried out during a spruce budworm outbreak which probably accounted for the large population there. The present findings agree more nearly with the figures of 79 pairs per 100 acres given by Palmgren (1930) for spruce forests in Finland and with those of 94 pairs per 100 acres given by Soveri (1940),

who also worked in Finland. However, Hayward (1948) reported a high summer bird population of 16.5 individuals per hectare (330 pairs ? per 100 acres) in the subalpine forest in Utah. In the montane forest in Utah he reported 15.5 individuals per hectare (310 pairs? per 100 acres) as the summer bird population. These figures were apparently estimated by means of cruising over measured areas usually 5 acres in extent. Such estimations, especially from small areas, often tend to result in population figures which are above the actual breeding density. Hering (1948) in a study of the bird population of the Black Forest in Colorado, which is predominantly ponderosa pine, found 96 pairs per 100 acres.

Discussion.—It is evident from table 1 that the four families (Fringillidae, Sylviidae, Turdidae and Paridae) with the most individuals are fairly well distributed among the three study areas. Furthermore, three of the five most abundant species are found in each of the three areas. In these cases the bird community did not change with the plant species but appeared correlated with the life form of the vegetation. The Ruby-crowned Kinglet, however, did not nest in the lodgepole pine plot, although this forest was intermediate in elevation between the subalpine forest and the montane forest, in each of which the bird was abundant. Apparently some feature of its niche was lacking. The junco occurred on plots 1 and 2, but at the elevation of the subalpine forest the birds were restricted to the edge conditions. In the two lower areas more edge existed within the census plots. It appears that this species is also reacting to the structure of the vegetation.

Thus, each species occupies its niche, even when it occurs in more than one plant community regardless of the species composition of plant dominants. Hayward (1945), in a study of coniferous forests in Utah, found a similar close biotic relationship between the montane and the subalpine forest. He found that almost 100 per cent of the mammal and 61 per cent of the bird species occurred through both forests. This correlation of animal communities with plant-life forms was apparently realized by some of the earlier workers (see Carpenter, 1939) although first clearly stated by Shelford (1913:307, 308) and Vestal (1913:13;1914:430).

COMMUNITY ORGANIZATION OF BIRDS

Bird distribution in the coniferous forest.—Kendeigh (1948) has recently recognized two biociations and five biocies in eastern North America. The climax and late seral plant stages of the coniferous forest, along with their constituent animals, constitute one biociation. Equivalent stages in the deciduous forest make up the other biociation. Each community has characteristic species which are adjusted to the respective vegetation types and which follow these types closely when occurring in mixed stands or ecotones.

In order to determine whether the coniferous forest biociation of the coniferous forest in the east is the same in the Rocky Mountains a comparison of the breeding bird population was made in table 2. Since this biociation includes only those species which occur in forests of relatively dense stands of trees and excludes those which require open forests or forest-edge conditions, these latter have for the most part been eliminated from the table as they really belong to the forest-edge biocies. The classification of only a few species offered any special difficulties. The breeding bird population for the Rocky Mountain region is the average of the three stations discussed in this paper. The population of the forest community in Ontario was determined by Kendeigh (1947). The area censused is situated about 90 miles north of Port Arthur, Ontario. This virgin forest is composed of 37 per cent balsam fir, 26 per cent black spruce, 6 per cent white spruce, 4+ per cent white cedar, jack pine, and tamarack, 23 per cent white birch, and 2 per

Table 2

Breeding Birds in the Climax Coniferous Forest

Community		Density per 100 acres (40 hectares)		
	Rocky Mountain coniferous forest	Eastern coniferous forest		
		Western Ontario	Maine
Dusky Grouse, *Dendragapus obscurus*	PR	1		
Franklin Grouse, *Canachites franklinii*	PR	*		
Williamson Sapsucker, *Sphyrapicus thyroideus*	LM	*		
Hammond Flycatcher, *Empidonax hammondii*	LM	*		
Steller Jay, *Cyanocitta stelleri*	PR	+		
Clark Nutcracker, *Nucifraga columbiana*	PR	+		
Mountain Chickadee, *Parus gambeli*	PR	11		
Chestnut-backed Chickadee, *Parus rufescens*	PR	*		
White-breasted Nuthatch, *Sitta carolinensis*	PR	*		
Pigmy Nuthatch, *Sitta pygmaea*	PR	*		
Varied Thrush, *Ixoreus naevius*	LM	*		
Townsend Warbler, *Dendroica townsendi*	LM	*		
Grace Warbler, *Dendroica graciae*	LM	*		
Goshawk, *Accipiter gentilis*	PR	*	+	*
Sharp-shinned Hawk, *Accipiter striatus*	PR	+	*	*
Horned Owl, *Bubo virginianus*	PR	*	*	*
Great Gray Owl, *Strix nebulosa*	PR	*	*	
Arctic Three-toed Woodpecker, *Picoïdes arcticus*	PR	*	2	*
Three-toed Woodpecker, *Picoïdes tridactylus*	PR	*	+	*
Olive-sided Flycatcher, *Nuttallornis borealis*	LM	*	*	*
Canada Jay, *Perisoreus canadensis*	PR	+	4	*
Hudsonian Chickadee, *Parus hudsonicus*	PR	*	2	*
Red-breasted Nuthatch, *Sitta canadensis*	PR	+	3	+
Brown Creeper, *Certhia familiaris*	PR	+	9	*
Winter Wren, *Troglodytes troglodytes*	PR	*	5	*
Hermit Thrush, *Hylocichla guttata*	LM	10	1	3
Golden-crowned Kinglet, *Regulus satrapa*	PR	*	8	23
Ruby-crowned Kinglet, *Regulus calendula*	LM	15	2	*
Solitary Vireo, *Vireo solitarius*	LM	*	2	*
Evening Grosbeak, *Hesperiphona vespertina*	PR	*	*	
Pine Grosbeak, *Pinicola enucleator*	PR	1	*	*
Pine Siskin, *Spinus pinus*	PR	19	1	*
Red Crossbill, *Loxia curvirostra*	PR	+	*	*
White-winged Crossbill, *Loxia leucoptera*	PR	*	*	*
Broad-winged Hawk, *Buteo platypterus*	LM		+	*
Pigeon Hawk, *Falco columbarius*	LM		+	*
Spruce Grouse, *Canachites canadensis*	PR		1	*
Black-capped Chickadee, *Parus atricapillus*	PR		2	9
Swainson Thrush, *Hylocichla ustulata*	LM		4	12
Tennessee Warbler, *Vermivora peregrina*	LM		59	*
Parula Warbler, *Parula americana*	LM		*	34
Magnolia Warbler, *Dendroica magnolia*	LM		6	26
Cape May Warbler, *Dendroica tigrina*	LM		28	4
Black-throated Green Warbler, *Dendroica virens*	LM		6	37
Blackburnian Warbler, *Dendroica fusca*	LM		6	15
Bay-breasted Warbler, *Dendroica castanea*	LM		92	1

Asterisk indicates occurrence of the species in the community but not on the census plot; PR, permanent resident or altitudinal migrant; LM, latitudinal migrant.

The list for the Rocky Mountains is compiled from various sources and pertains to areas from southern Canada southward; some species occur only in parts of this region.

cent quaking aspen. The figures for the Maine community are from the censuses (nine-year average) made by Cadbury and Cruickshank (1947) at Hog Island off the coast of Maine. The area consists of 25 acres of climax spruce and five partially cleared acres with buildings and young growth.

A study of table 2 shows that many species occur over a wide range within the coniferous forest. Those species which are found more or less throughout the coniferous forest comprise 46 per cent of the total. Such birds as the Golden-crowned Kinglet, Ruby-crowned Kinglet, Red-breasted Nuthatch, Olive-sided Flycatcher, and others tend to tie together the various parts of the biome. Many species are, however, restricted in regard to east-west distribution. Of the 46 species listed, 26 per cent are recorded only in the eastern two stations and another 28 per cent are listed only for the Rocky Mountain area. It appears that the species composition of birds in Ontario and Maine is essentially similar and that it differs markedly in the Rocky Mountains.

Table 3

Zoogeographic Origin of Breeding Birds in the Climax Coniferous Forest

	Percentage composition of population							
	Old World		North American		South American		Unanalyzed	
	species	pairs	species	pairs	species	pairs	species	pairs
Rocky Mountains	65	98	17	2	6	....	12	....
Ontario and Maine	52	20	30	79	3	....	15	1

Zoogeographic origin of the coniferous forest birds.—An analysis of the zoogeographic origin of the populations also indicates a difference between those of the Rocky Mountains and those of the more eastern forests (table 3). The data for Ontario and Maine are combined, and their population figures are averaged. The two communities are then analyzed both on the basis of breeding species and of breeding pairs. The place of origin of the various groups are taken from Mayr (1946). For most species this is based on the origin of the family. In a few cases the genus is used. For the Fringillidae the origin of the species is based on the subfamily to which it belongs. Four categories are used: Old World, North American, South American, and unanalyzed, the latter representing groups for which reliable interpretation of origin have not yet been obtained. The two types of analyses, by species and by pairs, are not entirely comparable. The analysis by pairs is based only on the actual communities censused while the analysis by species includes all that are listed in table 2. Obviously, these figures for pair analysis, representing only three localities, are indicative only and should not be considered as absolute values.

The South American element is relatively unimportant and will not be considered further in the present discussion. The analysis on the basis of breeding pairs shows an almost exclusive Old World element in the Rocky Mountain forests and a predominant North American element in the eastern forests. On the basis of species these differences are still evident although statistically they are not so extreme. Apparently the Old World forms in the east are not able to build up as high populations as do the North American forms. This may be because of the competition which they meet there with the high populations of North American parulids.

In the different plant communities in the Rocky Mountains the proportion of Old World birds in the population shows a correlation with elevation (fig. 11). Data for station 1 are from a census by Longley (1944) of a western hemlock-Douglas fir forest

near Bayview in northern Idaho. The data for station 2 are from a census by Hering (1948) of ponderosa pine in the Black Forest, Colorado. The data for stations 3, 4, and 5 are from the Colorado censuses described in this paper. The entire bird populations are included in this analysis, although some stations include a mixture of other vegetation types. From figure 11 it can be seen that the increase in Old World elements in the populations corresponds to an increase in altitude.

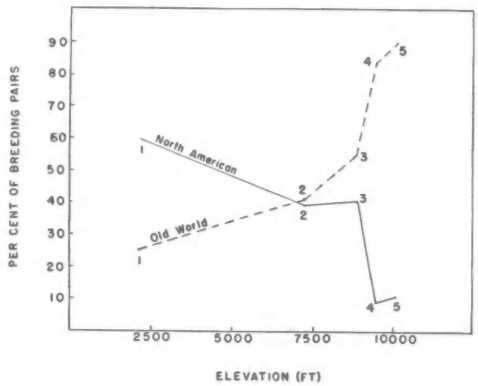

Fig. 11. Relation between numbers of pairs of species of Old World origin and those of North American origin in western forests at various elevations. 1, western hemlock-Douglas fir (Idaho); 2, ponderosa pine (Colorado); 3, Douglas fir-ponderosa pine (Colorado); 4, lodgepole pine (Colorado); 5, Engelmann spruce-subalpine fir (Colorado).

Station 1, according to the description by Longley, apparently has the greatest amount of deciduous growth. The relative amounts of coniferous and deciduous vegetation for station 2 are not available. The percentage of coniferous vegetation in the communities increases gradually from station 3 up to station 5. It is evident that the increase in the amount of coniferous vegetation with altitude is correlated with the increase of the Old World element in the bird populations. The influence of the altitude in producing this result may be partially, at least, an indirect one, its effect being to cause a change in the vegetation. When the influence of the vegetation is removed by analyzing only the coniferous forest birds, the Old World element (breeding pairs) shows an occurrence of 64 per cent at station 1, 53 per cent at station 2, 100 per cent at station 3, 100 per cent at station 4, and 80 per cent at station 5. Mayr (1946) has pointed out that the Old World element decreases on the continent from north to south, and the above figures extend this principle to a decrease also with decreasing altitude.

The Old World element was also shown by Mayr (1946) to be composed in large part of non-migratory birds, which probably had become adapted to cold during development in Asia and later invasion into North America from the north. Of the coniferous forest species occurring in the Rocky Mountains (table 2), 74 per cent are either permanent residents or move only to lower elevations in the winter. In the particular communities censused in Colorado these cold-adapted species made up 56 per cent of the breeding pairs. Thus, the latitudinal migrants, the non-cold adapted birds which move south

during the winter, comprise less than one-half of the breeding population. In Ontario and Maine, on the other hand, only 58 per cent of the species are permanent residents, and in the communities censused they contributed only 17 per cent of the breeding population. Certain migratory birds, such as the Golden-crowned Kinglet, have been placed in the resident group for the purpose of these calculations because the species by wintering in temperate or cold-temperate regions indicate adaptation to cold. Thus, in this respect, they are more similar to the non-migrants than to the migrants.

Eastern North America, perhaps because it was farther from the Alaskan land bridge or for other reasons, may not have received the Old World forms dispersing from Siberia as early as did the west. Such a situation would leave the east more available for indigenous elements and for invasion of South American groups. Since neither of these were primarily cold adapted groups, many of the species would have to assume a migratory habit to occupy the colder parts of the continent, while most of the Old World birds which came into the area would be cold adapted and could become permanent residents (see Mayr, 1946). The probable separation of the eastern and western coniferous forest during Pleistocene glaciation (Rand, 1948) may possibly have effected some differentiation between the avifaunas of the two regions. Factors such as these may account for the differences between the avian communities of the east and of the Rocky Mountain region.

Discussion.—The climax bird communities in the Rocky Mountains and in eastern North America differ in three important respects: (1) species composition, (2) zoogeographic origin, and (3) migratory status. Therefore, these regions represent two distinct biociations within the coniferous forest biome. The eastern community has been named and described by Kendeigh (1948) as the *Dendroica-Regulus* coniferous forest biociation. The western community may tentatively be distinguished as the *Parus-Spinus* coniferous forest biociation, after the Mountain Chickadee and Pine Siskin.

SUMMARY AND CONCLUSIONS

Censuses of breeding birds were carried out in three plant communities in the Rocky Mountains of Colorado. The populations per 100 acres (40 hectares) were: 102+ pairs in Douglas fir and ponderosa pine, 94+ pairs in Engelmann spruce and subalpine fir, and 59+ pairs in lodgepole pine. The most abundant species were the Mountain Chickadee, Ruby-crowned Kinglet, Hermit Thrush, Pine Siskin, and Gray-headed Junco, and all except the kinglet occurred in each of the three communities.

In the Rocky Mountains, an increase in elevation is correlated with an increase in birds of Old World origin and a decrease in birds of North American origin. This correlation is apparently brought about, in part, by the increase in the percentage of coniferous forest and the decrease in the percentage of deciduous forest in the vegetation at higher elevations.

In the climax coniferous forest community in the Rocky Mountains most of the breeding pairs are of species of Old World origin and are in large part permanent residents. In the east the North American element is in the majority, and the birds are largely migratory.

The distribution, zoogeographic origin, and migratory status of the breeding populations indicate that at least two distinct climax avian communities occur in the coniferous forest biome of North America. The Rocky Mountain community is named the *Parus-Spinus* coniferous forest biociation after the Mountain Chickadee and the Pine Siskin to distinguish it from the *Dendroica-Regulus* coniferous forest biociation of eastern North America.

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GEOGRAPHIC VARIATION IN THE PIGEON GUILLEMOTS OF NORTH AMERICA

By ROBERT W. STORER

A comparative study of the murres and guillemots now in progress by the writer has brought to light geographic trends in wing, tarsal, and culmen lengths in the populations of the Pigeon Guillemot (*Cepphus columba*) on the Pacific coast of North America. These trends are shown in table 1. Wing length decreases from California to Washington and British Columbia and increases from there to northern Alaska. Trends in tarsal length vary in the same directon but are not so marked. Culmen length varies clinally, decreasing from south to north. Thus, there is a long-winged, long-billed population inhabiting California, a short-winged, moderately long-billed population in Washington and British Columbia, and a long-winged, short-billed population in northern Alaska and eastern Siberia. At present all three are included within the form known as *Cepphus columba columba* Pallas.

Two other races of the Pigeon Guillemot are currently recognized, *Cepphus columba kaiurka* Portenko, the small, short-billed form of the Commander and outer Aleutian (Kiska and Atka) islands, and *Cepphus columba snowi* (Stejneger), of the Kurile Islands, a form in which the white in the speculum is reduced or absent.

The type locality of *Cepphus columba* is given by Pallas (Zoogr.-Rosso-Asiatica, II, 1811:348), as Kamtschatka and Bering Strait. The Pigeon Guillemots inhabiting both these areas belong to the long-winged, short-billed form which therefore must be called *Cepphus columba columba*. As there are no names available for the two forms to the south, I propose that they be named.

Cepphus columba adianta, new subspecies

Type.—No. 101,528, Mus. Vert. Zool., male in breeding plumage, collected by Allan Brooks, March 24, 1926, at Nanaimo, Vancouver Island, British Columbia.

Diagnosis.—Wing short, nearly as short as in *C. c. kaiurka;* bill moderately long, but shorter than in Californian birds. Wing length, 171 to 191 mm. (180.2 ± 0.4, $\sigma = 4.42$); tarsal length, 31.5 to 37.5 (34.57 ± 0.10, $\sigma = 1.08$); culmen length, 31.0 to 38.5 (34.61 ± 0.13, $\sigma = 1.44$). This short-winged form with a moderately long bill is best distinguished from the nominate race and from the Californian birds by a combination of wing and bill lengths, and from *kaiurka* of the outer Aleutian and Commander islands by its longer bill. No sexual differences in measurements have been found and accordingly data for the sexes are combined.

Range.—The coasts of Washington, British Columbia and southern Alaska, from the mouth of the Columbia River north to and including the Alaska Peninsula and the Aleutians at least as far west as Unmak Island.

The guillemots of southern Alaska and the eastermost Aleutians are included in this form although intermediate between it and the nominate race. The population of the central Aleutians is presumably intermediate between *adianta* and *kaiurka* but may further approach *columba*. At present too few specimens are available to clear up this point.

The differences in wing length and bill length in the various populations of the Pigeon Guillemot are suggested by the measurements of Ridgway (Birds N.M. Amer., pt. 8, 1919:741).

The name is derived from the Greek, *a*, the privative, plus *diantos* = capable of being wet and alludes to the dense, water-proof plumage of these birds.

Cepphus columba eureka, new subspecies

Type.—No. 31,462, Mus. Vert. Zool., male in breeding plumage, collected by W. H. Osgood, June 19, 1894, on the Farallon Islands.

Diagnosis.—Wing long as in *C. c. columba* from Siberia and the islands of Bering Sea. Bill longer than in any other race of *columba*. Wing length, 176 to 197 (187.5 ± 0.3, $\sigma = 4.04$); tarsal

length, 32.5 to 39.0 (36.13 ± 0.10, $\sigma = 1.27$); culmen length, 33.5 to 39.5 (36.57 ± 0.12, $\sigma = 1.40$). This form is best distinguished from *adianta* by a combination of bill and wing lengths and from *columba* by its much longer bill.

Range.—The coasts of California and Oregon from San Clemente Island north to the mouth of the Columbia River.

The Oregon population is intermediate between the Californian one and *adianta*, but perhaps is nearer the former. Until a larger series from Oregon and the west coast of Washington can be examined, it seems best to set the boundary between the two subspecies arbitrarily at the Columbia River. The few specimens from the coast of Washington, south of Cape Flattery, are closest to *adianta* and lend support to the adoption of this boundary.

That the Californian and Alaskan birds should belong to different subspecies was suggested by Grinnell (Univ. Calif. Publ. Zool., 5, 1910:367) who noted that Alaskan specimens were "decidedly blacker than specimens from the coast of California. There appear to be differences in proportions also; but the inadequacy of the available material does not warrant conclusions as to their constancy." I have been unable to verify Grinnell's statement regarding the greater intensity of the black of the Alaskan birds by examination of the series in the Museum of Vertebrate Zoology; but it is possible that this difference may be more evident in fresh material.

The name, *californica*, was not used for this form as it has already been applied to the California Murre with which the guillemots are still considered congeneric by a few people. I see no justification for this view; but in order to prevent possible nomenclatorial complications, I have used the name *eureka*, which is the motto of the state of California.

Table 1

Geographic Variation in *Cepphus columba*

Population	Wing length[1]				Tarsal length				Culmen length			
	No.	Mean ± σm	σ	V	No.	Mean ± σm	σ	V	No.	Mean ± σm	σ	V
California	172	187.5 ± 0.32	4.01	2.14	157	36.13 ± 0.10	1.27	3.52	161	36.53 ± 0.11	1.35	3.69
Oregon	18	187.2 ± 0.94	4.00	2.13	18	35.39 ± 0.29	1.25	3.53	18	35.19 ± 0.25	1.06	3.01
Washington and British Columbia	118	180.2 ± 0.41	4.42	2.45	118	34.57 ± 0.10	1.08	3.14	129	34.61 ± 0.13	1.44	4.15
Alaskan coast from Alaska Peninsula southward	93	183.2 ± 0.44	4.12	2.30	105	34.64 ± 0.13	1.28	3.69	102	33.97 ± 0.13	1.32	3.89
Islands of Bering Sea[2] and Siberia	46	186.3 ± 0.57	3.84	2.06	41	34.76 ± 0.18	1.17	3.35	41	32.35 ± 0.21	1.37	4.22
Outer Aleutian and Commander islands	19	177.2 ± 0.88	3.82	2.16	27	33.72 ± 0.23	1.19	3.53	25	31.20 ± 0.26	1.32	4.24

[1] Wing length was measured with the wing straightened along the measuring device. It is therefore several millimeters longer than the chord of the closed wing.

[2] St. Matthew, St. Lawrence, the Diomedes, Sledge and King islands.

Owing to the difficulty of assembling adequate series of birds as large as guillemots, it seems worth while to present the statistical data which have indicated to me the desirability of recognizing the various races of the Pigeon Guillemot discussed in this paper.

In forms which differ in one mensural character, the standard deviation (σ) of that character is usually the best means of estimating the number of individuals of one form which can be separated from those of other forms. Approximately two-thirds of a normal curve lie within one standard deviation to each side of the mean, and it follows that approximately five-sixths (83 per cent) will lie below the mean plus one standard deviation or above the mean minus one standard deviation. Thus if in two populations the difference between the means for a character is greater than the sum of the standard

deviations, more than 83 per cent of one population will be distinguishable from 83 per cent of the other on the basis of that character. This test has been applied to the subspecies *columba, kaiurka, adianta,* and *eureka* in table 2, from which it will be seen that more than 83 per cent of *kaiurka* are distinguishable from more than 83 per cent of *columba* on the basis of wing length, from more than 83 per cent of *adianta* on the basis of culmen length, and from more than 83 per cent of *eureka* on the basis of both characters. *Cepphus columba columba* is similarly distinct from *eureka* on the basis of culmen length. The differences between *adianta* and *columba* and *eureka* are not so great in either wing or culmen length.

Table 2

The Difference between Means and the Sum of the Standard Deviations for Wing Length and Culmen Length of Pairs of Races of *Cepphus columba* (calculated from the data in Table 1)

		Wing		Culmen	
		m_1-m_2	$\sigma_1+\sigma_2$	m_1-m_2	$\sigma_1+\sigma_2$
kaiurka	*eureka*	*10.3*	7.8	*5.33*	2.67
kaiurka	*columba*	*9.1*	7.7	1.15	2.69
kaiurka	*adianta*	3.0	8.2	*3.41*	2.76
columba	*eureka*	1.2	7.9	*4.18*	2.72
adianta	*eureka*	7.3	8.4	1.92	2.79
adianta	*columba*	6.1	8.3	2.26	2.81

One might then question the desirability of recognizing *adianta*. Were this form in the center of a cline in wing length as well as one in culmen length, I would not consider naming it. However, since it is shorter-winged than the two adjacent races, *columba* and *eureka,* there is a point in separating it if a sufficient proportion of its members is distinguishable. As *adianta* differs from both adjacent forms in two mensural characters, the lengths of the wing and culmen, discriminant functions can be used to combine the length of the wing (w) with that of the culmen (c) into one figure (x) which will maximize the differences between adjacent forms. The formula will be $x = aw + bc$ where a and b are the discriminant functions obtained as described by Mather (Statistical Analysis in Biology, 1947:152-159). These functions will be different for each pair of populations compared.

The results of these calculations for the values of x for comparing the specimens of *adianta* with those of *columba* and *eureka* are shown in table 3 from which it will be seen that the difference between the means is greater than the sum of the standard deviations in both instances.

Table 3

The Values of aw + bc for *C. c. adianta* as Compared with *C. c. eureka* and *C. c. columba*

	Number	Mean $\pm\sigma m$	σ
adianta versus *eureka*			
$a = 1.59, b = 3.54$			
adianta	100	407.8±0.9	9.1
eureka	179	427.4±0.7	8.7
adianta versus *columba*			
$a = 6.5, b = -8.5$			
adianta	100	882.0±3	28
columba	40	940.0±4	24

As a check, the wing and culmen lengths of the specimens of each race were compared with the mean and standard deviation of each other race. The results of these comparisons are shown in table 4 and will be found to agree with the estimates indicated by tables 2 and 3.

Table 4

The Percentage of Individuals of One Race Distinguishable from 83 Per Cent of Another Race

		Using individual characters				Characters combined using discriminant functions	
Per cent of	Distinguishable from 83 per cent of	Both wing and bill	Wing only	Bill only	Not distinguishable	on the basis of π	Not distinguishable
kaiurka (18)[1]	*eureka*	100.0	0.0	0.0	0.0	----	----
eureka (179)	*kaiurka*	92.7	0.0	7.3	0.0	----	----
kaiurka (18)	*columba*	33.3	61.1	0.0	5.6	----	----
columba (40)	*kaiurka*	42.5	45.0	2.5	10.0	----	----
kaiurka (20)	*adianta*	.....	....	100.0	0.0	----	----
adianta (100)	*kaiurka*	.....	....	90.0	10.0	----	----
columba (40)	*eureka*	.....	....	97.5	2.5	----	----
eureka (179)	*columba*	.....	....	99.4	0.6	----	----
adianta (100)	*eureka*	62.0	14.0	17.0	7.0	89.0	11.0
eureka (179)	*adianta*	50.8	26.3	14.5	8.4	88.8	11.2
adianta (100)	*columba*	46.3	21.5	19.0	13.2	88.0	12.0
columba (40)	*adianta*	50.0	27.5	22.5	0.0	85.0	15.0

[1] The numbers in parentheses are the numbers of specimens of each race used in the analysis.

Although the method of using standard deviation is useful in determining the distinctness of adjacent forms, I am opposed to the use of it or of any other arbitrary rule for determining the validity of subspecies. The line between what is to be or not to be recognized as a subspecies is an artificial one drawn for the convenience of systematists and as such, to be of most value, should be flexible enough to cover the variety of different situations which arise.

Discriminant functions have been used to advantage in a number of biological fields and should prove of considerable assistance in the taxonomy of birds. Their principal drawback is the length of the calculations involved. Their use in separating *C. c. adianta* from *C. c. columba* and from *C. c. eureka* is a good example of how they may be used in practice. I am indebted to Dr. R. R. Ronkin of the University of Delaware for pointing out the value of these functions and to him and to Dr. C. C. Craig of the University of Michigan for assistance in working out the formulas.

Museum of Vertebrate Zoology, Berkeley, California, and University of Michigan Museum of Zoology, Ann Arbor, Michigan, July 28, 1949.

NOTES ON THE BIRDS OF WRANGELL AND VICINITY, SOUTHEASTERN ALASKA

By J. DAN WEBSTER

In 1946 I returned for a period of five months to the vicinity of Wrangell, southeastern Alaska. From March 25 to August 23, on each of five days a week several hours were spent afield, hiking or rowing. Specimens of birds taken in this period are now in the California Academy of Sciences.

The Wrangell area has been visited by many ornithologists, the first being C. P. Streator in 1895. Extensive work was done by the following: George Willett, for seven months in 1920-21 (Willett, 1921*a*, 1921*b*, 1928); Fred H. Gray, who lived in Wrangell from 1899 to 1937 (Willett, 1921*b*); H. S. Swarth, on Wrangell and Mitkof islands for nineteen days in the summer of 1909 with Allan Hasselborg (Swarth, 1911), and on Sergeif Island for 21 days in August and September, 1919, with Joseph Dixon (Swarth, 1922). Work on the Stikine River below Telegraph Creek has been reported by Swarth (1922). The erection of a huge pulp mill at Point Agassiz, only 45 miles north of Wrangell, is expected in the near future. It may be anticipated that the largely virgin forests of the region will soon give way to logged-off "deserts" like those which now line the once-green waterways of the southern and central British Columbia coast.

Point Highfield is the northernmost tip of Wrangell Island and is only 2½ miles across Eastern Passage from the mainland at the southern edge of the mouth of the Stikine River. The town of Wrangell is a mile south of Point Highfield, on the west coast of the island; Polk Point is a mile southeast of Point Highfield, on the east coast. LeConte Bay is an ice-choked fiord 20 miles north of Wrangell; it is the site of the southernmost tidewater glacier on the Pacific coast. Sergeif Island, in the mouth of the Stikine (see Swarth, 1922:140) has a high grass-grown sand bar strewn with giant driftwood snags, which extends for a mile westward from the west end of the timbered part of the island. North and east of the bar are miles of grassland and marshes which are extensively flooded only by extreme tides. The only tules (*Scirpus*) I have ever seen in Alaska grow in a small marsh at the northeast corner of Sergeif Island. Two miles east of Sergeif Island is Point Rothsay, the promontory on the south bank which marks the official entrance to the Stikine River Channel; average flood tides ascend no farther. Proceeding upstream, successive landmarks along the Stikine are: Farm Island, Kakwan Point, Popof Creek, Warm Spring Slough, Clearwater Creek, the British Columbian boundary, and the Customs House. Aaron Creek is a small mainland river 20 miles southeast of Wrangell; the Berg Mine high camp is four miles north of the mouth of Aaron Creek, on a small tributary creek, at 700 feet elevation.

Most of the area worked is in the Canadian Zone; it consists of mountains forested with Sitka spruce (*Picea sitchensis*) and Western Hemlock (*Tsuga heterophylla*) and narrow valleys in which there are usually small muskegs dotted with lodgepole pine (*Pinus contorta*). Above about 2000 feet the spruce-hemlock gives way to Hudsonian Zone characterized by yellow cedar (*Chamaecyparis nutkatensis*) and alpine hemlock (*Tsuga mertensiana*); above about 3000 feet or a little higher there are only bare rock and alpine meadows (Arctic Zone). Intertidal grasslands are extensive at the mouth of Aaron Creek and are vast at the mouth of the Stikine.

Along the lower Stikine River there is an association of cottonwood (*Populus trichocarpa*), willow (*Salix* sp.), alder (*Alnus rubra*), and devil's club (*Echinopanax horridum*) which covers many square miles; it is almost continuous along the banks and covers practically all the islands for the 30 miles from the British Columbia-Alaska

boundary to Point Rothsay. Elsewhere in southeastern Alaska this plant association, with its attendant bird species, is found only in very small strips along the other large mainland rivers. Swarth and Dixon in 1919 touched the upper part of this association, at Great Glacier, British Columbia, 15 miles above the boundary (Swarth, 1922:143). In the most advanced subclimax communities, there are dense stands of large cottonwoods, with dense underbrush of willow, devil's club, and alder, and here and there a spruce sapling. The common breeding land birds are: Ruffed Grouse, Western Wood Pewee, Hermit Thrush, Russet-backed (Swainson) Thrush, Robin, Yellow Warbler, Myrtle Warbler, Warbling Vireo, and Song Sparrow.

I made trips up the Stikine as follows: May 28, upstream along the south shore three miles from Point Rothsay and return, afoot; June 8 to 10, upstream by river boat to the boundary, then downstream in a rowboat to Wrangell; July 5 to 7, as in June; August 5 and 6, upstream by rowboat to a tributary creek four miles above Point Rothsay, and up the creek a mile, then return the same way.

The following list of species includes: (1) records believed to represent contributions to the knowledge of the avifauna of southeastern Alaska as a whole, and (2) records which are additions to the knowledge of the avifauna of the Stikine River above Point Rothsay, as reported by Swarth (1922). "Southeastern Alaska" refers to that portion of the territory south of Yakutat Bay.

Gavia immer. Common Loon. On the Stikine, one was seen in the mouth of Clearwater Creek on June 9.

Phalacrocorax auritus. Double-crested Cormorant. Evidently a migrant near Wrangell. Single birds were seen on four occasions on Eastern Passage: March 28, April 26, May 13, and May 16.

Branta canadensis. Canada Goose. There are few published references to the small form *B. c. minima* in southeastern Alaska, although it seems to be a regular migrant. Large flocks flew north along Eastern Passage on April 27 and May 2. A flock of ten was grazing on Sergeif Island on May 13; a female was taken from a grazing flock of 90 there on May 16. That *B. c. occidentalis* breeds on the lower Stikine was indicated by the actions of several geese seen between the boundary and Point Rothsay on June 8, 9, and 10. On July 6 a flock in Clearwater Creek consisted of five adults herding about 20 two-thirds grown young. Specimens of *occidentalis* were recorded by Swarth (1922:200) from Sergeif Island in August.

Chen hyperborea hyperborea. Snow Goose. A flock of 25 was flushed from Sergeif Island on April 30, a flock of 30 from there on May 2. On the latter day a young male, almost finished with its molt into white plumage, was taken. Near Polk Point one was flushed from the beach on May 9; a flock of fifteen flew upstream over the Customs House at the boundary on the Stikine on June 9. The specimen taken is the first to be recorded from southeastern Alaska, although the species has been taken regularly by hunters and there have been sight records by Swarth (1911:45), Bailey (1927:189), and Webster (1941:120).

Spatula clypeata. Shoveller. A flock of four, including one female, was seen on Sergeif Island on May 13. There were four females in a flock of twelve there on May 16.

Mergus serrator. Red-breasted Merganser. From one to four were seen each day on Eastern Passage from March 26 to 30 and from April 10 to 12. On April 7 one was seen in Shoemaker Bay four miles south of Wrangell. On my first visit to Sergeif Island on April 15, about 500 Red-breasted Mergansers were fishing in the almost clear water of the river mouth. Large numbers were seen in that vicinity on April 20 and 30 and on May 2. The ice came out of the Stikine the first week in May and thereafter its color was like that of the Missouri River. Only a few mergansers were seen from then on, usually in the clear water at mouths of tributary creeks.

Accipiter gentilis atricapillus. Goshawk. A male shot in Wrangell on March 28 is in the streaked first-winter plumage and is indistinguishable from numerous specimens from northern Alaska and the western United States.

Buteo jamaicensis. Red-tailed Hawk. On the Stikine, one moderately light-colored bird circled over the lower end of Warm Spring Slough on July 6.

Falco columbarius. Pigeon Hawk. Single birds were seen on the Sergeif Island bar on August 14 and 19. On the last date the bird was taken and proved to be an adult female of the race *suckleyi*, the first specimen ever reported from southeastern Alaska. It is as dark as the darkest individual of the 25 specimens of *suckleyi* in the collections of the California Academy of Sciences and the Museum

of Vertebrate Zoology. Previous records of *suckleyi* in southeastern Alaska are sight records, but Nelson (1887:148) reported a specimen from Sitka which approached *suckleyi* in darkness of plumage.

Lagopus mutus dixoni. Rock Ptarmigan. At least fifteen miles of alpine ridges were traversed afoot in the mainland mountains between the Stikine and Aaron Creek on three days in June and July, but only one ptarmigan was seen. It was an adult male of this race, taken on June 25 at 3300 feet on Wrangell Peak.

Bonasa umbellus. Ruffed Grouse. Drumming was heard in the cottonwoods along the Stikine River on June 9 at Popof Creek and on an island nine miles above Point Rothsay. The following morning, drumming was heard on an island eight miles above Point Rothsay. My hunting was unsuccessful, although several acquaintances told of bagging many Ruffed Grouse along the river in fall and early spring. No specimen has been recorded from southeastern Alaska.

Grus canadensis. Sandhill Crane. The spring migration is very early; a friend reported a flock of five seen over Point Highfield on April 5. Single birds, probably representing a small breeding population, were seen on May 13 at Sergeif Island and on August 22 at Polk Point.

Pluvialis dominica fulva. Golden Plover. The only Golden Plover seen was taken—an adult female, April 30 on the Sergeif Island bar. The wing length, 164 mm., places it definitely in this race, as does the color (Conover, 1945:571).

Charadrius vociferus. Killdeer. Evidently a regular migrant. A single bird was seen near Polk Point on April 16, 17, and 18. On the Sergeif Island bar, two were seen on May 2 and one on August 15. Another circled low over our house in Wrangell, calling vigorously, the afternoon of August 13.

Tringa solitaria cinnamomea. Solitary Sandpiper. An immature female was taken on August 15 on the Sergeif Island bar and another was seen there that same day.

Actitis macularia. Spotted Sandpiper. Several seen along the Stikine on June 9 and 10 and July 6 and 7 acted as though nesting; so did four pairs in LeConte Bay on June 18, 19, and 20. Two males in breeding condition were taken in LeConte Bay on June 18 and 20; the bird of June 18 was guarding a set of half-incubated eggs.

Erolia melanotos. Pectoral Sandpiper. Seen only on Sergeif Island, as follows: one on May 13, 40 on May 16, one on June 13 (no appearance of nesting), 50 on August 15, five on August 19. Specimens were taken in May and August.

Lobipes lobatus. Northern Phalarope. Flocks on Eastern Passage on April 20 totaled about 400 birds; two females were taken. A small flock was seen in Eastern Passage on April 22 and one there on April 30. Thereafter the species was not seen.

Larus canus. Mew Gull. A Stikine record was provided by two adults which flew near my skiff in the middle of the Stikine River off Shakes Creek on July 6.

Larus argentatus. Herring Gull. A pair of adults flew downstream past my rowboat off Shakes Creek on June 9. On July 6 four, all adults, were seen along the river between the boundary and Shakes Creek. The present species, as well as the preceding, was not reported by Swarth (1922), but probably breeds somewhere along the Stikine.

Larus glaucescens. Glaucous-winged Gull. The single Stikine record of this salt-water gull consists of an adult seen near Kakwan Point on June 8.

Sterna paradisaea. Arctic Tern. Several were seen along the lower Stikine on each of the following days: June 8, 9, and 10; July 5, 6, and 7. Two pairs acted as though nesting on a large sand bar a mile below Clearwater Creek, but extensive search for eggs on July 5 and 6 was unsuccessful. A female taken there on the latter day had recently laid a set and had a well developed brood patch.

Brachyrhamphus brevirostris. Kittlitz Murrelet. Several were seen among the icebergs in LeConte Bay on June 18, 19, and 20. Two females and a male taken were evidently incubating eggs. This record is the southernmost and easternmost for the species, the previous extreme records being in Sitka Sound by Willett (1914:74) and Palmén (1887:393) and in northern Chatham Strait by Bailey (1927:15). I was able to distinguish between this species and the common Marbled Murrelet (*Brachyrhamphus marmoratus*) by a difference in their voices. The call of the Kittlitz Murrelet was a hoarse, long-drawn-out squawk which contrasted with the high-pitched, mournful wail of its congener.

Nyctia scandiaca. Snowy Owl. One of these owls was shot just east of Wrangell by some boys on January 12, 1946. They brought it to Mr. George Lemke, who saved some feathers for me to check the identification.

Chaetura vauxi. Vaux Swift. A few were seen overhead in the alder-grown valley about the Berg Mine high camp on July 16, 18, and 21. Presumably they were nesting on the steep cliffs above.

Nephoecetes niger. Black Swift. At Sergeif Island flocks were seen overhead, four birds on June 13 and eight on August 14.

Megaceryle alcyon. Belted Kingfisher. Several were noted along the Stikine between the boundary and Kakwan Point on June 9 and July 6.

Colaptes cafer cafer. Red-shafted Flicker. Flickers have not previously been reported in winter from southeastern Alaska. Mr. and Mrs. Jackson L. Webster and Mr. and Mrs. George Lemke reported one or two birds seen frequently in Wrangell in the winter of 1945-1946. Mr. Webster salvaged some secondaries from a bird taken on January 16, which are readily identifiable with this subspecies.

Sphyrapicus varius ruber. Yellow-bellied Sapsucker. On the Stikine, two were seen at the boundary and one at Clearwater Creek on June 9 and three were seen at the boundary on July 6. A male taken on the latter date is in the juvenal plumage of the coastal race.

Empidonax traillii traillii. Traill Flycatcher. Two were seen and one taken in a grassy marsh partly grown to alders and willows on an island in the Stikine seven miles above Point Rothsay on June 10.

Contopus richardsonii richardsonii. Western Wood Pewee. The familiar call of this species was heard in the willow-cottonwood thickets beside Clearwater Creek on June 9. The next day, a pair was seen and the male taken on a cottonwood-covered island eight miles above Point Rothsay.

Nuttallornis borealis. Olive-sided Flycatcher. One that was seen and heard in the tall spruces along Clearwater Creek on June 9 succeeded in keeping beyond shotgun range. There are no previous summer records from southeastern Alaska, nor any Stikine records from west of Telegraph Creek (Swarth, 1922:225).

Tachycineta thalassina. Violet-green Swallow. The only one seen was a single bird in a mixed flock of swallows over the Sergeif Island bar on August 15.

Iridoprocne bicolor. Tree Swallow. On July 7, single birds were seen as far up the Stikine as seven miles above Point Rothsay.

Corvus caurinus. Northwestern Crow. Small groups of these beach-combers were seen as far upstream on the Stikine as seven miles above Point Rothsay on June 10 and up to the southeast corner of Farm Island on July 7.

Parus rufescens. Chestnut-backed Chickadee. None was seen along the lower Stikine more than three miles upstream from Point Rothsay.

Cinclus mexicanus. Dipper. Not previously reported from the Stikine region. There were two sight records upstream from Point Rothsay: one was seen on May 28 along a small tributary creek and on July 7 two were carrying food along a cascade at the upper end of Farm Island.

Anthus spinoletta pacificus. Pipit. Pipits were common at sea level in April and in early May, the last spring record being a flock of 30 seen on May 7 on the beach near Polk Point. Later the species was seen only in the Arctic Zone, above 3000 feet on mainland mountains. On June 25, July 17, and July 23, on mountains between the Stikine and Aaron Creek, several were seen and five adults were taken. On July 17 a juvenile, able to fly but a few yards, was taken, and proved to be in complete juvenal plumage. Robert T. Orr checked the racial identity of the specimens.

Bombycilla garrula pallidiceps. Bohemian Waxwing. Jackson L. Webster and George Lemke reported this species as abundant in Wrangell from November 27, 1945, to February 21, 1946. A dead bird was brought to Lemke on March 1; he saved the wing for me to identify.

Vireo gilvus swainsoni. Warbling Vireo. Along the Stikine on June 9, two were seen and one taken in a willow thicket beside Warm Spring Slough. That same day, the song of the species was heard in alder-willow thickets a mile downstream from the boundary and at the lower end of Warm Spring Slough. On July 6, one was seen in alders at the Customs House and the songs of two or more were heard at the lower end of Warm Spring Slough. The only previous record for the Territory of Alaska was from the Chilcat River by Jewett (1942:74).

Dendroica coronata hooveri. Myrtle Warbler. Several were seen and several more heard singing along the Stikine from the boundary down to eight miles above Point Rothsay on June 9 and 10 and July 6. On July 1 a female was feeding a flying juvenile in the willows on Sergeif Island. Two adult males were taken.

Oporornis tolmiei tolmiei. MacGillivray Warbler. On the Stikine, one was seen in the Indian celery and salmon berry bushes beside the Customs House on June 9; later that day one was singing a mile below the boundary. On July 6, the male at the Customs House was seen again. A pair was seen in a salmon berry thicket near Point Highfield, Wrangell Island, on June 14 (they could not be re-located subsequently), and a female near Polk Point on August 17. In the alder thickets above the Berg Mine high camp, at altitudes from 800 to 1100 feet, several were seen on July 19, 20, and 21. On the last date, a female was feeding a flying juvenile. Specimens were taken on July 20 and 21.

Geothlypis trichas campicola. Yellow-throat. Along the Stikine, a male was seen and two others heard singing in a grassy marsh partly grown to alder and willow on an island seven miles above Point Rothsay on June 10. On July 6, a male was seen in a small grassy marsh near the lower

end of Warm Spring Slough; the next day a small colony was located and two males were taken beside a beaver pond on Popof Creek. The well-cared-for beaver dam and lodge were several years old. There was a muskeg on one side of the pond, but the Yellow-throats were in the narrow fringe of grass and small willows bordering the pond. On July 28 two singing males were heard in the grassy marshes at the mouth of Aaron Creek; one was located and taken. The tules on Sergeif Island were examined in June and July without finding any Yellow-throats, but about fifteen were there on August 19 and an immature was taken. The only previous records for southeastern Alaska are from the mainland at Chickamin River and Taku River (Swarth, 1911:101-102). William H. Behle identified the three adult male specimens as belonging to the interior British Columbian race.

Setophaga ruticilla tricolor. Redstart. On June 9 three were seen on cottonwood-covered islands in the lower Stikine. A female was seen on an islet nine miles above Point Rothsay; a few minutes later on another island a mile downstream a pair was seen and the male taken. This is the first definite record from Alaska.

Burroughs (1902:40) reported the "Redstart" as one of the species collected by the Harriman Expedition, June 9 to 13, 1899, on Point Gustavus, Glacier Bay, without comment. Probably this was a slip of the pen for "Redpoll," which is a fairly common bird of that region, but which was not listed. Ridgway (1907) apparently took account of all the warblers collected on the Harriman Expedition in Alaska and noted no Redstart from Alaska. It seems reasonable to assume, therefore, that Burroughs was in error.

Agelaius phoeniceus arctolegus. Red-winged Blackbird. One was taken on Sergeif Island on July 1 (Webster, 1948:228).

Piranga ludoviciana. Western Tanager. A female was seen in a cottonwood tree beside Warm Spring Slough, a channel of the Stikine River, on June 9.

Pinicola enucleator alascensis. Pine Grosbeak. On January 10, 1946, Jackson L. Webster found a dead bird on a street in Wrangell and saved the bill, wing, tail, and feathers for me. The parts represent a subadult male of this race, which has not previously been reported from southeastern Alaska. It seems probable that a large proportion of the Pine Grosbeaks wintering in southeastern Alaska belong to this interior race rather than to the locally resident race *flammula.* South of Glacier Bay, the latter seems to constitute a very small total population.

Loxia curvirostra. Red Crossbill. The species has not been reported from the Stikine between Telegraph Creek and Sergeif Island (Swarth, 1922:233). On June 9 small flocks were seen flying overhead at the boundary, at Clearwater Creek, and beside Warm Spring Slough. On June 10 and July 7 small flocks were seen in a clump of spruces on an island seven miles above Point Rothsay.

Passerella iliaca. Fox Sparrow. Two Fox Sparrows taken at Polk Point on April 22 and May 4 proved to be of the race *unalaschcensis.* A Fox Sparrow taken at Polk Point on May 7 was of the race *insularis.* The first Fox Sparrows of the year were seen about Polk Point on April 9; the one specimen taken that day was a female of *sinuosa.*

In the course of the breeding season, a sample of the Wrangell Island population was obtained, a nesting pair being taken on June 14 in a salmon berry patch near Point Highfield. These birds are referred to *fuliginosa,* although they are slightly indicative of intergradation with *townsendi* as shown by somewhat rustier dorsal coloration than that of mainland specimens. The only previous summer specimen from Wrangell Island, reported by Swarth (1920:198 and 1922:263), was referred to *townsendi.* Perhaps the Wrangell Island population is a variable group of intergrades.

There have been no breeding Fox Sparrows reported from the mainland of southeastern Alaska south of Glacier Bay, although Swarth (1922:261-262) reported five *fuliginosa* taken in early August at Great Glacier, British Columbia, on the Stikine River only fifteen miles north of the boundary, and one migrant *fuliginosa* from Sergeif Island taken on August 19, 1919; on this basis he assigned the entire mainland of Alaska, south of the Stikine, to the range of *fuliginosa.* On the lower Stikine I took two of three singing males from a large alder thicket on an island seven miles above Point Rothsay on June 10. On July 6 and 7 the song of the Fox Sparrow was heard three times along the Stikine: at the lower end of Warm Spring Slough, on the south shore of the river opposite Popof Creek, and in the same thicket where the June specimens had been taken. In the Aaron Creek drainage, Fox Sparrows were found breeding in the brushy valley above the Berg Mine high camp, in alder and salmon berry thickets at elevations of 800 to 1200 feet, from July 16 to 21; three adults were taken. All mainland specimens are *fuliginosa,* closely matching Swarth's seven Great Glacier specimens. As noted by Swarth (1922:262-263), *fuliginosa* of the Stikine region differs appreciably from more southerly (Vancouver Island) specimens of that race, particularly in the duller (less tawny) brown color of back and lower tail coverts. However, I have seen no breeding specimens of *fuliginosa* from points south of Vancouver Island, and only one good summer bird from there (Mus. Vert. Zool. no. 16253, pictured in Swarth, 1920, plate 4, fig. 2, facing page 218).

A migrant Fox Sparrow (Calif. Acad. Sci. no. 60584) was taken on April 25 on the beach at Polk Point which is very difficult to classify. I hesitantly identify it as *fuliginosa*, because dorsally it matches the Stikine River birds. Ventrally it matches nothing else; almost the entire breast is deep brown, tinged faintly with rusty on the feather tips. In this connection, it is recalled that Willett (1928:448) reported taking a melanistic specimen of *townsendi* at Craig, Alaska. The specimen was loaned by the Los Angeles Museum and compared by Robert T. Orr at the California Academy of Sciences. Dr. Orr writes: "The ventral spotting of the specimen (L. A. Mus. no. 21097, Craig, Prince of Wales Island, October 22, 1919) is no more extensive than in your series of *fuliginosa* (excluding 60584). The spots, however, tend to be slightly more blackish. Number 60584 is much more heavily pigmented below. Dorsally the Willett Fox Sparrow is very slightly more reddish than any of the birds in your series." We may surmise, then, that no. 60584, a migrant from Wrangell Island, and L. A. Mus. no. 21097, a migrant from Prince of Wales Island, represent different segments of the Fox Sparrow population of the mainland of southeastern Alaska, north of the Stikine River and east of Glacier Bay. Both may be best referred to the subspecies *fuliginosa*.

Melospiza lincolnii gracilis. Lincoln Sparrow. Swarth (1922:260) reported specimens of this race from Sergeif Island and from Flood Glacier, British Columbia, 85 miles upriver, but he gave no records from the intervening country. Two were seen beside a little marsh near the lower end of Warm Spring Slough on July 6, and one the next day beside the beaver pond on Popof Creek. Several specimens were taken on Wrangell Island and the nearby mainland in June and July. A migrant male of the race *lincolnii* was taken on May 4 at Polk Point. In the California Academy of Sciences is another specimen of this race from southeastern Alaska, a male taken on April 27, 1916, at Ketchikan, by J. A. Kusche. A third specimen, a male which I took at Polk Point on May 8, seems to be intermediate between the locally breeding race, *gracilis*, and the northern and eastern race, *lincolnii*. Miller and McCabe (1935) did not report any specimens of *lincolnii* from southeastern Alaska, but the above three specimens contrast in color (browner back, with narrower stripe) with breeding series and the first two in wing length (longer, 63 and 62 mm.). It seems reasonable to conclude that the race *lincolnii* is a regular spring migrant through this coastal region.

Melospiza melodia morphna. Song Sparrow. Swarth (1922:256) reported specimens of *rufina* from Sergeif Island and from Flood Glacier, British Columbia. Later he made a revision of the northwestern Song Sparrows (1923) wherein all the mainland of southeastern Alaska south and east of Glacier Bay and the eastern islands of the Alexander Archipelago were assigned to the range of *morphna* and the breeding range of *rufina* was restricted to the western islands of the Alexander Archipelago and the Queen Charlotte Islands. Swarth recognized only one subspecies from British Columbia exclusive of the Queen Charlottes, although he noted four populations, which differed very slightly on the average. Jewett (1942:75) referred a collection of Song Sparraws taken in June and July from several of the islands of the Alexander Archipelago as well as the Chilcat River and Cleveland Peninsula on the mainland to *rufina*. Recently, Munro and Cowan (1947:234-236) divided the breeding Song Sparrows of British Columbia, exclusive of the Queen Charlottes, into four races—*inexpectata, merrilli, morphna*, and *rufina*, corresponding to the four populations of *morphna* recognized by Swarth.

Song Sparrows were rather common along the lower Stikine on June 9 and 10 and on July 6 and 7. Specimens were taken on June 9 at the boundary and on July 6 at the lower end of Warm Spring Slough. In the identification of these two specimens, the Song Sparrows in the California Academy of Sciences and the Museum of Vertebrate Zoology were studied; the specimens were identified as *morphna*, approaching *rufina*.

Essentially, my views on Song Sparrow populations in southeastern Alaska and British Columbia are those of Swarth (1923). I studied six pertinent series of breeding adults, as follows: (1) fourteen *rufina* from Chicagof, Baranof, Forrester, Prince of Wales, and Duke islands, Alaska (taken from May 21 to July 6); (2) ten intermediates between *rufina* and *morphna* from Admiralty, Warren, and Wrangell islands and the lower Stikine and the east side of Glacier Bay, Alaska (May 21 to July 31); (3) twelve *morphna* from Chickamin River and Boca de Quadra, on the extreme south of the Alaskan mainland, and the upper Stikine River, British Columbia (June 1 to July 31); (4) twenty *morphna* from Vancouver Island (May 31 to July 31); (5) twelve *morphna* from Clatsop and Columbia counties, Oregon (May 18 to June 1); (6) eleven *morphna* from Hazelton, Clearwater P. O., and Indianpoint Lake, British Columbia (May 29 to July 13). The ten intermediates of series 2 are rather uniform in coloration; dorsally they are exactly between *rufina* and series 3 of *morphna*, but ventrally they are nearer (rustier, less sooty) *morphna*. Series 3 of *morphna* is indistinguishable, to my eye, from the Vancouver Island series, although a few of the extremes may be picked out as slightly different. I agree with Swarth that the race *inexpectata* Riley is not worthy of recognition and that the range of *morphna* extends north along the mainland coast to the eastern shore of Glacier Bay. I studied very few breeding specimens from that part of British Columbia assigned to the range of *merrilli* by Munro and Cowan (1947) and therefore can make no statement concerning that race.

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Robert T. Orr identified the Pipits, compared Willett's Fox Sparrow, and helped me in many other ways. William H. Behle identified the Yellow-throats. The authorities of the Museum of Vertebrate Zoology allowed me free use of the collections under their care.

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Jamestown College, Jamestown, North Dakota, December 6, 1948.

FROM FIELD AND STUDY

Olive-sided Flycatcher Feeding from Nest.—On June 19, 1948, with Mr. Ben Pruitt of Thurston, Oregon, I was working through the cut-over Douglas fir forest on West Point Hill, northeast of Coburg, Lane County, Oregon. An Olive-sided Flycatcher (*Nuttallornis borealis*) was seen perched on a high snag, from which it made feeding sorties in the characteristic flycatcher manner. After one of the flights from this snag it flew directly to a nest and settled on it. At two- and three-minute intervals in the course of the next 30 minutes the bird made sorties from the nest to catch passing insects, generally returning directly to the nest, but on several occasions flying to the snag or another nearby perch. On one occasion the flycatcher was chased from the top of the snag by a Sapsucker (*Sphyrapicus varius*).

The nest was situated in a small group of short-foliaged branches at the end of an isolated branch extending about ten feet out from the trunk and about 30 feet above the ground. There were no branches above the nest for at least another 30 feet, so that the bird on the nest had unobstructed visibility for at least 30 feet in all directions. Although I was unable to examine the nest, the way the bird settled upon it each time it returned indicated that eggs were being incubated.—GORDON W. GULLION, *Richmond, California, April 24, 1949.*

Warblers Lost at Sea.—On a trip from San Pedro, California, to Catalina Island in a small sailing boat on May 12, 1949, five or six Pileolated Warblers (*Wilsonia pusilla*) and one male Townsend Warbler (*Dendroica townsendi*) sought rest on the boat, and two of the first species also were seen dead on the water. There was a high overcast sky and visibility was about 6 miles.

The distance from Catalina to the mainland is about 18 miles. The first warblers were seen on our way to the island, approximately 6 miles from the mainland, at about 7:30 a.m. They were nearly exhausted but were apparently afraid of the vibration in the rigging caused by the auxiliary motor. They would remain only for a minute or two and then would try to continue on but would soon return, more exhausted than before. One of them was finally unable to rise high enough to reach the deck and fell into the water. This bird was rescued with a net but died in about an hour. When the motor was stopped, the birds remained for sometime hunting for insects among the rigging; but when the motor was started again they flew away and did not return.

The following day, on the return trip, a female Pileolated Warbler came aboard at about 7:30 a.m. when 5 or 6 miles away from the island; the island was still visible at the time. This bird seemed almost completely exhausted and soon found a resting place on a coil of rope on deck; she immediately tucked her head under her feathers and slept for some minutes. She then woke with a start and flew a few hundred feet, but returned, barely able to rise high enough to alight on the deck. After repeating this same performance several times she finally was unable to make the deck, and fell into the water. She was rescued and was content to rest in the warmth of my hands where she soon fell asleep. She died before we could liberate her on shore.—LEONARD H. DAY, *College of Agriculture, Davis, California, June 1, 1949.*

An Additional Available Passenger Pigeon Skeleton.—Pitelka and Bryant (Condor, 44, 1942:74-75) have published a list of seven available skeletons of the Passenger Pigeon (*Ectopistes migratorius*). The purpose of this note is to add an eighth to the list. The skeleton at hand is catalogued as accession number 743, University of Notre Dame Museum. Like the specimen reported by Pitelka and Bryant (Mus. Vert. Zool. no. 84315), ours bears the label of Ward's Natural History Establishment, and the entire label is legible. A copy of this label was sent to Ward's in the hope that a serial number (5567) in the lower left hand corner might prove to be a key to further information regarding the specimen. However, Mr. F. H. Ward replied that all of their records had been destroyed by fire. Other data on the label are identical with those reported by Pitelka and Bryant.

Measurements of the present specimen are as follows: length of coracoid, 30.0 mm.; length of carpometacarpus, 31.0 mm.; length of tarsometatarsus, 27.5 mm.; breadth of proximal end of tarsometatarsus, 6.2 mm.; breadth of distal end of tarsometatarsus, 7.1 mm.; breadth of shaft of

tarsometatarsus, 2.6 mm. These measurements compare favorably with those of the specimen reported by Pitelka and Bryant.

We are also fortunate in having three mounted skins of the Passenger Pigeon, entered as U.N.D. nos. 734, 735, and 7204, all of which are males. —EDWARD O. DODSON, *Department of Biology, University of Notre Dame, Notre Dame, Indiana, May 4, 1949.*

Gnatcatchers in Oregon.—On the morning of April 26, 1949, in the McKenzie River bottoms near Thurston, Lane County, Oregon, while out checking warbler migrations, I was attracted by some unfamiliar notes coming from a group of small birds in the tree tops. On closer inspection these proved to be Blue-gray Gnatcatchers (*Polioptila caerulea*). These birds, four in number, were feeding on insects around the blossoms and freshly opened leaf-buds of a clump of low, spreading, big leaf maples (*Acer macrophylla*) in open woodlands of mixed deciduous and coniferous trees. They were in almost constant motion, for the most part keeping well up in the trees, although one individual came down to the lower branches to within about twelve feet of me. These gnatcatchers were under close observation for fully fifteen minutes until they finally disappeared toward the north. They were followed soon by two others which entered the trees from the south and left as had the previous four.

Mr. and Mrs. A. Ray Wiseman recently reported to the local natural history society that a gnatcatcher spent the period from May 26 to June 2, 1949, in the trees and shrubbery at their home in Eugene, Oregon.

So far as I know there are no previously published records of gnatcatchers for the state of Oregon.—BEN H. PRUITT, *Springfield, Oregon, June 13, 1949.*

Notes on Flights of the Nighthawk.—Some observers have thought that migrations of Nighthawks (*Chordeiles minor*) occur in July. To me July seems rather early in the year for true migration, especially after I have observed large numbers of these birds feeding in flocks. If these flocks had been observed at just the right time of day, they most certainly would give the impression of migrating birds.

In the period from June to September, 1947, I was working at Hovenweep National Monument, Colorado, which is situated about forty miles west of Mesa Verde National Park. This section of country is made up of rolling mesa lands, transected by numerous dry canyons and covered with sagebrush (*Artemisia*) and a few scattered juniper trees (*Juniperus utahensis*). When we arrived there in June, not more than two pairs of nighthawks were present in the area and these were the only ones observed until near the end of July. On July 23 in the late afternoon a thunder storm rolled in across the desert and the darkening of the sky seemed to bring out the nighthawks. Throughout the storm we watched several of these birds going about their business of feeding, very much undisturbed by the lightning, noise, and downpour. Soon after the storm had passed over, we became aware of about twenty nighthawks flying westward about forty or fifty feet in the air, feeding and calling as they went. About an hour later we again saw these birds coming back, only now they were flying in and out among the low stunted junipers, feeding within ten feet of the ground. The whole group was now moving away from the failing light of the setting sun.

These evening flights to and from the west continued every evening. The number of birds increased until more than seventy-five could be seen feeding in an irregular line extending to the north and south. Then one morning after a heavy rain storm we woke to the sounds of the nighthawks and looked out to see a large flock flying to the west. With this early morning westward movement as number one, we counted five other definite mass movements at nearly equal intervals throughout the day. The birds always flew high on their way to the west and low to the ground coming back. Then on subsequent afternoons, especially after a rain storm, nighthawks would make as many as three west-east flights before it was too dark to see them. These flights were still taking place when we left the Monument on September 15.—CHARLES G. HANSEN, *Oregon State College, Corvallis, Oregon, July 15, 1949.*

Great Blue Heron Killed by a Carp.—Evidence of an unusual death of a Great Blue Heron (*Ardea herodias*) was found on October 3, 1947, at the north end of Reservoir No. 3, about 2 miles northeast of Waverly, Larimer County, Colorado. The dried head of the heron, with the remains

of a carp lodged within the mandibles, was picked up by W. L. Holmes and T. E. Kruse. This fish, approximately 12 inches in length, was apparently too large for the heron to swallow, and presumably when the bird attempted to regurgitate it, the anterior spine of the dorsal fin pierced the heron's gullet, making regurgitation impossible. The photograph (fig. 12) shows the serrated spine of the fish's anal fin in a position which permits swallowing of the fish head first; the spine of the dorsal fin is in the erected position after perforating the gullet wall. The photograph also shows that the heron attempted to swallow the carp with its ventral surface uppermost. It seems likely that

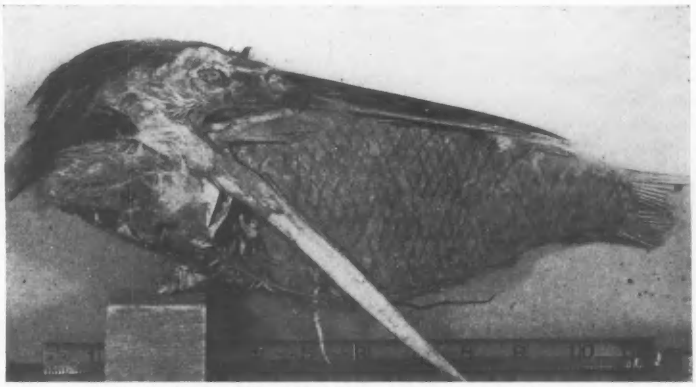

Fig. 12. Head of Great Blue Heron with carp lodged in gullet.

the heron, being unable to feed, slowly starved to death, or possibly died more quickly of suffocation. The object resting against the wooden block is the bird's trachea. I am indebted to Dr. D. F. Costello for the photograph.—RONALD A. RYDER, *Colorado Cooperative Wildlife Research Unit, Fort Collins, Colorado, July 26, 1949.*

Temperatures of Poor-wills in the Summer Season.—Knowledge of the significant observations on torpidity in the Poor-will (*Phalaenoptilus nuttallii*) made by Jaeger (Condor, 51, 1949: 105-109) led me to take such temperature records of this species as possible in the course of a summer's field work in northern Chihuahua, Mexico, in 1948. Jaeger recorded the startlingly low temperatures of a Poor-will while in winter dormancy. These varied from 18.0° to 19.8° (64.4-67.6° F.) when daytime temperatures ranged from 17.5° to 24.1° C. Presumably through day and night for approximately three months this bird existed at temperatures no higher than these. As basis for comparison, the normal temperatures of active Poor-wills should be known and evidence of daily temperature reduction during the sleeping periods of the summer season should be sought. To my knowledge only one other record of the temperature of a Poor-will has been reported. A reading of 107.2° F. was taken by Wetmore (Smithsonian Misc. Coll., 72, 1921:1-52) in the interclavicular area via the oesophagus in a male bird; the date and circumstances were not mentioned.

At Ramos, 4800 feet, an oasis 18 miles north and 8 miles west of Casas Grandes, Chihuahua, four male Poor-wills (*P. n. nuttallii*) were taken at dusk on September 2, 3, 5 and 8. Temperatures were obtained by thrusting a fast-registering thermometer, of the same type used by Jaeger, deeply into the oesophagus as far as the proventriculus. The temperatures were recorded quickly and maximum readings were registered within a minute of shooting, except in the last two birds which were carried wounded to camp a hundred yards distant where the record was soon taken. The readings were 41.0°, 41.8°, 41.0°, and 41.0° C. (105.8-107.2° F.), respectively. The air temperatures on the first two nights at the points of collecting were 20° C. The Poor-wills had been extremely active in foraging and calling in the period following sundown and before complete darkness set in. These temperatures of active birds accord well with Wetmore's single record and with a few figures for other caprimulgids which he gives.

Previously, on August 11, 7 miles southwest of Pacheco, 6700 feet, Chihuahua, I flushed a male Poor-will from a rocky slope at 10:30 a.m. The bird had been settled in its daytime roost in the rocks and was shot as it left. The temperature taken immediately as the bird was retrieved and while it was still alive was 34.0° C. (93.2° F.). The air temperature was 20° C. and there was a light rain. Even in the brief period of a minute in which the bird was flushed and the thermometer applied there may have been some rise in the bird's temperature. Yet the reading was 12° F. below that of the normal active condition and suggests that a rather pronounced lowering of temperature even in the summer season may occur during the daytime sleeping period. The daily lowering of temperature during sleep or rest in no species reported by Wetmore (*op. cit.*) involved readings lower than 99° F.—ALDEN H. MILLER, *Museum of Vertebrate Zoology, Berkeley, California, August 4, 1949.*

Data on Nesting Red-winged Blackbirds in Western Oregon.—The data on a breeding population of Red-winged Blackbirds (*Agelaius phoeniceus*) presented herein were gathered mainly in southern Benton County, Oregon, in the years 1941, 1942, 1946, 1947, and 1948. The Redwings began to establish their territories in the latter part of March, and nest construction started anytime from the first of April to late April, depending upon the weather. The earliest completed nest was found on April 8.

Clumps of sedges (*Carex obnupta* and *C. oregonensis*) and thin stands of spikerush (*Eleocharis palustris*) furnished the only "greenery" early in the nesting season. Most of the early nests, up to about mid-May, were placed in these plants, but as the nesting season progressed, Oregon ash (*Fraxinus oregana*), spirea (*Spirea douglasii*), and cattails (*Typha latifolia*) leafed out, and more and more nests were placed in them. The selection of vegetation-type for nest sites is as follows:

Month	Sedge	Spirea	Ash	Spike-rush	Cattail	Grass	Total
April	9	2	....	2	....	1	14
May	25	9	4	6	6	....	50
June	12	11	11	....	5	....	39
Total	46	22	15	8	11	1	103

Exceptions to the above-described progression are one early nest placed in reed canary grass (*Phalaris arundinacea*) and two early nests in leafless spirea. The latter were placed low in the spirea and were afforded much cover by the sedges growing around the base of the shrub.

April 15 was the earliest egg date. Full sets of four eggs were not found earlier than April 22. The peak of the first nesting period was the first week of May, and it ended the last part of May. A second period of nesting occurred when favorable water conditions existed in the swamp and marsh areas. There was usually a blending of the two periods of nesting. The peak of the second period of nesting was the second and third week of June. Circumstances did not permit the author to follow the second nesting through to completion, but full sets of eggs have been seen as late as June 25. Most nests were empty by July 8. These nestings were predominantly in ash and spirea. Since a majority of the nests observed in the first period of nesting were successful in putting forth young birds, I feel that this second period is a second nesting rather than a renesting of earlier unsuccessful pairs. There were about 80 nests in the first period and 60 nests in the second period.

Records were also kept of heights above the water surface of 103 nests. The measurements were made only at the time the nests had either eggs or young in them and represent distance to the rim. The ranges in heights of the nests for each vegetation type are as follows:

Height in inches	Sedge	Spirea	Ash	Spike rush	Cattail	Grass	Total
up to 12	8	....	....	5	....	....	13
13 - 24	28	2	2	3	....	....	35
25 - 36	10	6	7	....	1	1	25
37 - 48	....	9	4	....	10	....	23
49 - 72	....	5	2	....	....	....	7
Total	46	22	15	8	11	1	103

Of the 103 recorded nests, it is thought that only 40 had full sets of eggs at the time of observation; 25, or 62.5 per cent, of these nests had the normal full set of 4 eggs; 8, or 20 per cent, had only 3 eggs; and 7, or 17.5 per cent, had sets of 5 eggs. These figures may give an erroneous sug-

gestion of productivity. It should be noted that only one nest was seen to contain five young, all in the "pin-feather" stage. The majority of nests produced either three or four young. Few nests had only one or two young. The three- and four-young nests sometimes also contained one or two bad eggs or dead or dying young.

It is interesting to note that Gabrielson and Jewett (Birds of Oregon, 1940:525) give the inclusive egg dates of this species as May 3 to June 6 in contrast to the inclusive egg dates, April 15 to June 25, given in this paper.

Although the Redwing has been considered a permanent resident in western Oregon, the bulk of the local summering population moved out of the study area in late July. Thus there was a period of approximately four weeks when only occasional individuals were seen before a large Redwing population was again present. This situation probably results from the local dispersal of the birds over the surrounding country as the last young leave the nest.—FRED G. EVENDEN, JR., *United States Fish and Wildlife Service, Sacramento, California, July 9, 1949.*

Road-runner in Eastern Oklahoma.—Near the top of Kiamichi Mountain, two miles north of Honobia, Pushmataha County, Oklahoma, I observed a Road-runner (*Geococcyx californianus*) on May 5, 1948. The record is of interest because the locality is only 27 miles from the western Arkansas boundary, in which state the bird will undoubtedly be reported within a few years. Recent reports of Road-runners in Louisiana give testimony of the eastward extension of range within recent years.

It seems probable that the invasion of mesquite in Texas rangelands, as an accompaniment of overgrazing, has bridged grassland barriers and enabled the bird to reach naturally forested areas.—PHILIP F. ALLAN, *Soil Conservation Service, Fort Worth, Texas, April 10, 1949.*

Additions to the Avifaunal Record of Santa Cruz Island, California.—The period from August 28 to September 14, 1948, was spent on Santa Cruz Island, Santa Barbara County, California. In the records available from that island, late summer and early fall are poorly represented seasons, and it is therefore not surprising that noteworthy data on occurrence for as many as 29 species were recorded. These are reported here together with late breeding dates for six additional species and notes on extent of early fall migration. All records have been evaluated by reference to Howell (Pac. Coast Avif. No. 12, 1917: 1-127), Willett (Pac. Coast Avif. No. 21, 1933:1-204), and Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:1-608). In the text which follows repeated reference to these is omitted. Localities mentioned are to be found on a map published by Bremner ("Geology of Santa Cruz Island . . .," Santa Barbara Mus. Nat. Hist. Occas. Papers No. 1, 1932: plate 1).

Ardea herodias. Great Blue Heron. Recorded from Santa Cruz Island only in April, 1911. One was observed near Prisoner's Harbor almost daily from August 29 through September 12.

Phasianus colchicus. Ring-necked Pheasant. Introduced on Santa Cruz Island some years ago and evidently maintaining itself in small numbers at least in the vicinity of Prisoner's Harbor and the central ranch headquarters. A female in a late stage of postjuvenal molt was taken at Prisoner's Harbor on September 10.

Charadrius vociferus. Killdeer. Heretofore this species has been considered to be merely a winter straggler to coastal islands. A small group, perhaps representing a family, was present throughout the period of our visit along Cañon del Puerto, the canyon leading from Prisoner's Harbor to the central ranch headquarters. A ranch foreman reported them to be present the year around.

Actitis macularia. Spotted Sandpiper. One appeared on the stone beach at Prisoner's Harbor on September 9. Previous records for Santa Cruz Island apply to winter and spring seasons.

Tyto alba. Barn Owl. Although reported but twice previously from the island, this species is considered a rare resident. My only record was one in flight over Prisoner's Harbor heard late in the evening of September 12.

Calypte anna. Anna Hummingbird. Supposedly a resident of at least some of the Santa Barbara Islands, but no definite nesting records are available. Not recorded from Santa Cruz Island between late April and November. Near Prisoner's Harbor, one was seen on August 29 and another on September 6. On September 11, one was seen in the pine area at the head of Christy Cañon.

Balanosphyra formicivora. Acorn Woodpecker. A small population, evidently resident, was present along the Cañon del Puerto. Two adult males were collected on August 31 and September 3, respectively. Although these woodpeckers occurred usually in the vicinity of the larger canyon-bottom

trees, they were observed to move some distance up some of the side canyons. These movements suggested only routine foraging activities. I made trips into or through the main canyon almost daily, but woodpeckers were not encountered on each trip and once, when sought, they could not be located. At the time of our visit at least, they were neither very conspicuous nor noisy.

The Acorn Woodpecker was not known to occur on the coastal islands prior to 1927. Pemberton (Condor, 30, 1928:147) reported it from an area of suitable habitat on Santa Rosa Island, where it was heard on April 2 and two individuals were seen on April 3, 1927. In 1930, Hoffmann (Condor, 33, 1931:171) observed Acorn Woodpeckers at three localities on Santa Cruz Island, and in 1931 he saw them again at one of the same localities. A specimen now in the Museum of Vertebrate Zoology was collected on May 1, 1931, by H. H. Sheldon in "cottonwoods in cañon, east base of Mt. Diablo." Hoffmann (*loc. cit.*) contended that this species had "invaded the island only lately," but I think there is some room for argument on this point.

Tyrannus verticalis. Western Kingbird. Three previous records for Santa Cruz Island were all obtained in the month of April. Two immature individuals were collected at Prisoner's Harbor, one on September 2, the other on September 7. A third individual was seen there on September 10.

Myiarchus cinerascens cinerascens. Ash-throated Flycatcher. There is one previous fall record, September 3, 1903. Single individuals were seen at or near Prisoner's Harbor on September 1 and 3, and an immature individual of unknown sex was collected on August 31.

Empidonax traillii brewsteri. Traill Flycatcher. Previously unreported from any of the Channel Islands. An immature male, very fat, was taken at Prisoner's Harbor on September 1.

Troglodytes aëdon parkmanii. House Wren. There is but one island record, an immature male collected on September 3, 1903. Single individuals were observed on September 3, 7, and 13 near or at Prisoner's Harbor, and one immature male was collected there on the 6th. Two were seen at the Christy Ranch, near the mouth of Christy Cañon, on September 11.

Troglodytes troglodytes pacificus. Winter Wren. There is but one island record for this species, also, a specimen collected on Santa Cruz on October 23, 1908. An immature female was collected at Prisoner's Harbor on September 10. Another individual was seen on September 13.

Polioptila caerulea. Blue-gray Gnatcatcher. Although suspected to occur as a resident on Santa Cruz Island, the available records are few and fall in the months from October through December. One was observed on August 30, and a group of three or four was noted on September 1.

Bombycilla cedrorum. Cedar Waxwing. There is but one previous record for Santa Cruz Island (April 5, 1915), and two records from other islands are for the months of May and November, respectively. Two individuals in juvenal plumage were present at Prisoner's Harbor from September 1 to 6.

Vireo gilvus swainsoni. Warbling Vireo. Considered a vagrant on coastal islands, but one record, an individual heard on April 4, 1915, being available from Santa Cruz Island. A very fat female was collected on September 6 at Prisoner's Harbor. Other individuals were observed on September 3 and 10.

Vermivora ruficapilla ridgwayi. Nashville Warbler. Recorded only from San Nicolas Island (May 1, 1929). Two immature individuals were collected at or near Prisoner's Harbor, the first a male on August 30, the second probably of the same sex on September 6. Observed a number of times on the intervening days.

Vermivora virginiae. Virginia Warbler. But one previous record of this species is available for the Pacific slope, an immature female taken in San Diego County, California, on September 3, 1931. An immature female, very fat, was collected at Prisoner's Harbor on September 8.

Dendroica aestiva. Yellow Warbler. No records are available from coastal islands. An immature, very fat specimen of unknown sex was taken at Prisoner's Harbor on September 7. Observed also on September 9, 12 and 13.

Dendroica townsendi. Townsend Warbler. There is but one previous record from Santa Cruz Island, a specimen taken on December 13, 1907. I collected an immature female at Christy Ranch on September 7.

Geothlypis trichas. Yellow-throat. Two specimens previously collected on Santa Cruz Island, on December 28, 1927, and in January, 1920, are said to represent *G. t. occidentalis* and *G. t. scirpicola,* respectively. There is also a sight record for San Clemente Island, March 23, 1915, listed under the

former. An immature male taken on September 12 in the cattail marsh at Prisoner's Harbor represents *G. t. occidentalis*. A female was observed there on September 9 and 10, and an immature female was caught in a mousetrap on the 13th.

Wilsonia pusilla. Wilson Warbler. Recorded in periods of migration only from Catalina, Santa Barbara, San Nicolas, and Anacapa islands. Observed repeatedly in the vicinity of Prisoner's Harbor, Santa Cruz Island, from August 29 to September 12. An immature male, collected on August 31, represents *W. p. chryseola*.

Agelaius phoeniceus. Red-wing. A juvenal male which came in to Prisoner's Harbor on September 6 and was collected appears to represent *A. p. neutralis*. No other blackbirds were observed Sight records of this species have been reported from Santa Catalina (listed under the name *A. p. neutralis*), but there are no records for any of the other islands.

Icterus bullockii. Bullock Oriole. Previous records for Santa Cruz and other coastal islands apply to the spring season only. Observed almost daily in the period from September 2 to 8 at or near Prisoner's Harbor.

Piranga ludoviciana. Western Tanager. Recorded but once previously from Santa Cruz Island, on September 3, 1903. Noted on several days at or near Prisoner's Harbor in the period September 2 to 12. In the early morning of September 5, two drifted through the pine forest at the head of Christy Cañon.

Pheucticus melanocephalus. Black-headed Grosbeak. There are but two records for Santa Cruz Island; only for one of these is a date available, April 27, 1898. The only other island record is one from San Nicolas, April 26, 1929. One to several grosbeaks were noted daily from August 31 to September 11.

Passerina amoena. Lazuli Bunting. A migrant for which no fall records are available from the Channel Islands. One to several individuals noted daily in the vicinity of Prisoner's Harbor from September 1 through 8.

Passerculus sandwichensis. Savannah Sparrow. Previous records from Santa Cruz Island reported with dates apply to winter and spring seasons. A flock of six migrant individuals appeared on the high beach at Prisoner's Harbor on September 5, and the species was in evidence through the 12th. An immature male collected on September 10 represents *P. s. brooksi*. This race has been reported from Santa Cruz Island previously by Peters and Griscom (Bull. Mus. Comp. Zoöl., 80, 1938:463).

Pooecetes gramineus. Vesper Sparrow. Not recorded from the coastal islands. A migrant individual appeared briefly on the high beach at Prisoner's Harbor on September 12.

Chondestes grammacus. Lark Sparrow. Recorded but once previously from Santa Cruz Island, in November, 1907. A single individual was observed at Christy Ranch on September 11.

Single instances of several species in last stages of breeding activity were observed: Scrub Jay (*Aphelocoma coerulescens insularis*), September 6, adults feeding at least one well-grown fledgling (all three individuals collected); Hutton Vireo (*Vireo huttoni*), August 31, adult feeding well-grown fledgling; House Finch (*Carpodacus mexicanus*), September 3 and 5, adult followed by well-grown fledgling begging for food repeatedly; Spotted Towhee (*Pipilo maculatus*), September 1, adult followed by two well-grown fledglings begging for food; Rufous-crowned Sparrow (*Aimophila ruficeps*), August 29, pair with at least two bob-tailed fledglings no more than two or three days out of the nest. In addition, a nest of the Mourning Dove (*Zenaidura macroura*) with two fresh eggs, the female incubating, was found on September 1 in a scrub oak five feet above the ground.

With one probable exception (*Vireo gilvus*), specimens of migrants collected were immature individuals. In this category are 16 specimens representing 13 terrestrial species. It seems likely that under ordinary weather conditions such as prevailed during my stay on Santa Cruz Island, adults of these species move southward along mainland routes and probably appear on the island, in the early fall at least, only occasionally. Thus, the wandering young-of-the-year would comprise the bulk of land migrants that appear on Santa Cruz and probably other nearby islands.

Our camp was at Prisoner's Harbor on the north shore, and there the varied terrain, deserted gardens, marsh, and fresh water attracted more migrants than were seen elsewhere on the island. Almost daily new arrivals were detected, but they drifted into the area in such small numbers that there was no suggestion of a wave of migrants, and only on the mornings of September 2 and 12

were groups of them at all noticeable. The most common of the migrants was the Pileolated Warbler. Most of the others were represented by no more than one to several individuals on each encounter.

It may be helpful in future work to mention names of actual, supposed or suspected resident species which I did not encounter at any time. No Burrowing Owls (*Speotyto cunicularia*) were found (where would they nest?), nor were any Cooper Hawks (*Accipiter cooperii*), Red-breasted Nuthatches (*Sitta canadensis*), English Sparrows (*Passer domesticus*) or Pine Siskins (*Spinus pinus*). I saw no Crossbills (*Loxia curvirostra*) and agree with Willett (Pac. Coast Avif. No. 21, 1933:165) that their breeding on Santa Cruz Island is unlikely.—FRANK A. PITELKA, *Museum of Vertebrate Zoology, Berkeley, California, July 2, 1949.*

Robin Feeds Fledgling a Snake.—Bent (U. S. Nat. Mus. Bull. 196, 1949:25-28, 57-59) lists many strange items as food of the Robin (*Turdus migratorius*), including snails and fish fry, but makes no mention of reptiles in the diet.

In the evening of August 9, 1946, I watched two parent Robins feeding their fledglings on a lawn in Eugene, Oregon. One parent caught a three-inch garter snake (*Thamnophis* sp.) and offered it to one of the young birds. The young refused the violently writhing snake. The parent then hopped to one side, pecked the snake several times and again offered it to the youngster. Four times the young bird refused the snake and each time the parent moved away to peck the snake some more. Finally, when offered the now limp snake a fifth time, the fledgling accepted and promptly swallowed it. Following this episode the parent continued feeding the fledgling earthworms and other invertebrates.—GORDON W. GULLION, *Richmond, California, December 31, 1949.*

A New Name for the Canada Jay of the Rainbow Mountains of British Columbia.—Stresemann (Ibis, 91, 1949:252) has recently shown that the name *Corvus pacificus* Gmelin (Syst. Nat., ed. 13, 1(1), 1788:372, no. 32) is applicable to the race of Canada Jay of western Alaska for long known as *Perisoreus canadensis fumifrons* Ridgway. With the early name *pacificus* thus coming into use in the genus *Perisoreus*, it is necessary to supply a new name for *Perisoreus canadensis pacificus* Miller (Condor, 45, 1943:117), the race of Canada Jay inhabiting the Rainbow Mountain area of coastal British Columbia. I therefore propose as a substitute: *Perisoreus canadensis arcus*, nom. nov.—ALDEN H. MILLER, *Museum of Vertebrate Zoology, Berkeley, California, December 23, 1949.*

NOTES AND NEWS

Fig. 13. Robert B. Moran, member of the Cooper Club since June 9, 1897.

The twenty-first Annual Meeting of the Cooper Ornithological Club will be held at Asilomar in the Monterey area on April 14, 15 and 16, 1950. Meetings at Asilomar are characterized by informality and exceptional opportunity for members to become acquainted and to talk of their interests in birds. The costs at Asilomar are very reasonable and should make it easy for members to attend. A major purpose of the Annual Meetings is to develop a scientific program. You are urged now to begin planning a contribution to the program. The committee on arrangements will issue a call for papers and a request for individual reservations at Asilomar about March 1.

The Guatemalan Ivory-billed Woodpecker (*Phloeoceastes guatemalensis dorsofasciatus* Moore) which Grayson encountered in Sinaloa was known locally as Pito Real. The specimens on which he based the painting reproduced in this issue were taken on November 1, 1864, at Barone on the Río Mazatlán. All those shown in the group are females; the males are portrayed in a separate drawing less perfectly designed.

Grayson writes: "I have generally found this woodpecker among large forests or seeking its food high up upon decayed trees and sometimes even green ones when such a tree becomes infected with the wood cutting worm or borer." These are "its general food and the perserverance and industry it exhibits ferreting out with its powerful wedge-shaped bill these destructive insects from the tough wood common to the country, is very interesting to behold. The termite . . . is also a favorite food . . . . Its habits are something like the Ivorybill of the southern states, to which it seems to be allied . . . . I have always found it alone, excepting in the breeding season."

The frontispiece of the Ivory-billed Woodpecker is presented through the generosity of Jean Delacour, Edgar S. Roth, and Mr. and Mrs. Otto J. Zahn.

The Tenth International Ornithological Congress, to be held at Uppsala, Sweden, from June 10 to 17, 1950, is open to persons of all countries interested in any phase of ornithology. Several excursions based on Lund are planned for the period June 3 to 9 before the sessions, and others departing from Uppsala, June 20 to July 3, following the meetings. Dr. Alexander Wetmore, Secretary, Smithsonian Institution, Washington, D.C., is President, and Prof. Sven Hörstadius, Zoologiska Institutionen, Uppsala, Sweden, Secretary, for the Congress. To insure quarters and place on the excursions, applications for registration should be addressed before February 28, 1950, to Tenth International Ornithological Congress, Uppsala, Sweden.

COOPER CLUB MEETINGS

NORTHERN DIVISION

OCTOBER.—The regular meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, October 6, 1949, at the University of California, Berkeley, California. The following names were proposed for membership: Herbert Girton Deignan, Smithsonian Institution, Washington 25, D.C., by Alden H. Miller; Gilbert Greenwald, 2411 Bowditch St., Berkeley 4, Calif., by Howard L. Cogswell; Mrs. Mabel Holtz Petrishin, 1465 21st Ave., San Francisco, Miss Florence B. Stanton, P.O. Box 738, Berkeley, Calif., Mrs. Ernest Koch, 1188 Dolores St., San Francisco 10, Calif., and Mr. J. Ross McFadyen, 2510 Bancroft Way, Berkeley

4, Calif., all by Mrs. Junea W. Kelly, the last named as a sustaining member. The proposals to elect John McB. Robertson, J. R. Pemberton, and Stanley G. Jewett to honorary membership were re-read; it was voted unanimously so to elect each of these men.

Mr. C. A. Harwell spoke on "The Birds of the Churchill Area, Manitoba" and showed color motion pictures which he took there during the past summer.—HOWARD L. COGSWELL, *Secretary*.

NOVEMBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held at the University of California, Berkeley, on November 3, 1949, at 8:00 p.m. A resolution was adopted expressing regret at the death of Henry Ward Carriger. The following proposals for membership were read: Mrs. Karl W. Onthank, 1653 Fairmount Blvd., Eugene, Ore., by Gordon W. Gullion; Donald James Burdick, 1148 Martin Ave., San Jose 11, Calif., by Charles G. Sibley; Archie Stanton Mossman, Museum of Vertebrate Zoology, University of California, Berkeley 4, Calif., by Howard L. Cogswell; Edwin Philip Pister, Bowles Hall, University of California, Berkeley 4, Calif., by S. Kent Carnie; and Mrs. Charles B. Andrews, High Bridge, New Jersey, Harry B. Goldstein, 5939 Addison St., Philadelphia 43, Pa., Mrs. Osborne Mitchell, Streetsville, R. R. 1, Ontario, Canada, and Jason Alison Walker, 89 Church St., Waterloo, N.Y., all by Junea W. Kelly.

Junea W. Kelly reviewed Maurice Broun's "Hawks Aloft," and James Fisher's "Bird Recognition." Seth Bailey reported a Red-bellied Hawk between Stinson Beach and Olema on October 16. Lawrence Curl reported an Osprey at Stinson Beach on the same date.

Charles G. Sibley gave a talk entitled "A Wyoming Field Trips," illustrated with Kodachrome slides and motion pictures.—HOWARD L. COGSWELL, *Secretary*.

DECEMBER.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held at the University of California, Berkeley, on December 1, 1949. The following proposals for membership were read: Dr. Prentis T. Burtis, 2500 Edwards Ave., El Cerrito, Calif., by S. Kent Carnie; Richard Bailey, 2226 Blake St., Berkeley 4, Calif., by Junea W. Kelly; Miss Evelyn Van Scyoc, 2940 Van Ness Ave., San Francisco 9, Calif., and Miss Florence Plymell, 1865 California St., San Francisco 9, Calif., by Mrs. Vee K. Curtis. Mrs. Kelly named the following as a nominating committee for officers for the Northern Division for 1950: Alden H. Miller, John Chattin and W. I. Follett.

Gordon Gullion reported seven Starlings in El Cerrito on November 25. Cogswell reported a Solitary Vireo singing from a willow thicket near San Pablo Reservoir on November 27.

Alden H. Miller gave a talk entitled "New Bird Acquaintances in Colombia," illustrated with Kodachrome slides of the upper Magdalena Valley and adjacent mountains and with specimens.—HOWARD L. COGSWELL, *Secretary*.

SOUTHERN DIVISION

NOVEMBER.—The regular monthly meeting of the Southern Division of the Cooper Ornithological Club was held on November 29, 1949, at the University of Southern California, Los Angeles. The following names were proposed for membership: C. B. Edwards, Box 105, Jamul, Calif., by L. M. Huey; Ruth E. Ernsberger, 302-G Groves St., China Lake, Calif., and Donald W. Moore, Fleming House, Cal. Tech., 1301 E. California St., Pasadena 4, Calif., by Wm. R. Fish; William M. Rubey, 16 Westwood Dr., Washington 16, D.C., by John McB. Robertson; Roland D. Walters, Box 148, La Sierra College, Arlington, Calif., by A. H. Miller; Frank C. Winter, 210 W. 7th St., Los Angeles 14, Calif., by Harold Michener; Mrs. La Prelle Edens, 4415 W. 5th St., Los Angeles 5, Calif., and Robert L. Pyle, 851 Malcolm Ave., Los Angeles 24, Calif., by D. E. Groner; Elizabeth B. Hone, 633½ N. Friends Ave., Whittier, Calif., John Francis McClure, 7050 N. Oatman, Portland 17, Ore., and Francis Harold Rudkin, Jr., 458 Fillmore St., Fillmore, Calif., by Sidney B. Peyton; Richard H. Adelson, 34 Wensley Dr., Great Neck, Long Island, N.Y., Mary A. Bennett, Western Illinois State College, Macomb, Ill., Lois Garrett, 1709 Chestnut St., Kenova, West Va., Frederick Greeley, 1121 Rutledge St., Madison 3, Wis., William C. Grimm, Pocono Lake, Penn., Lawrence I. Grinnell, 710 Triphammer Rd., Ithaca, N.Y., A. M. Guhl, Dept. of Zoology, Kansas State College, Manhattan, Kan., Donald Crosby MacBrine, 2730 S. Normandie, Los Angeles 7, Calif., and Fred P. Roullard, Fresno State College, Fresno 4, Calif., all by C. V. Duff.

Two colored motion pictures, "Fine Feathers" and "Bird Migration," were shown, followed by informal discussion.—DOROTHY E. GRONER, *Secretary*.

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WANTED—Auk, vol. 1, no. 2; vol. 2, no. 2; vol. 3, no. 4; vol. 5, no. 1; vol. 6, no. 1. Wilson Bulletins for 1899, nos. 27 and 29.—IRA N. GABRIELSON, *Wildlife Management Institute, Investment Bldg., Washington, D.C.*

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January 1, 1950

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